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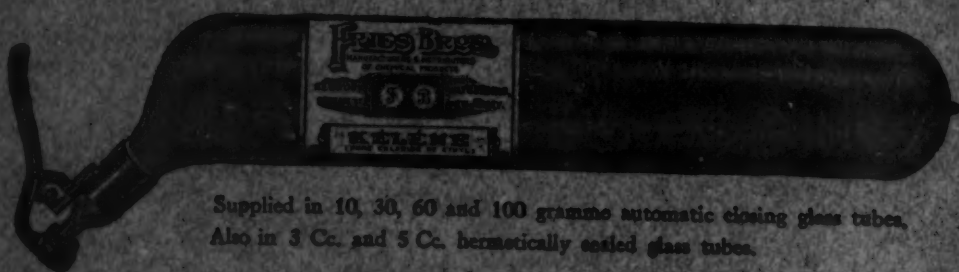
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ANNALS *of* SURGERY

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No. 2

COLONIC ANÆSTHESIA IN OPERATIONS UPON BRAIN AND SPINAL CORD*

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INTRODUCTION.—Muller's well-written paper on the "Changing Status of Anæsthetics" (ANNALS OF SURGERY, August, 1927), as the title implies, emphasizes the present unsettled state in the selection and popularity of anæsthetics. From that historical date 1846, there have been many shifts from one anæsthetic to another, chloroform to ether, to nitrous oxide, to ethylene, spinal and splanchnic, regional and local. And during these transitional periods, or really almost at the beginning, Pirogoff (*Recherches pratiques and physiologiques sur l'etherization*, St. Petersburg, 1847) proposed the introduction of ether into the rectum. In the same year others reported their experiences with the injection of ether, pure, or in aqueous solution. For some reason or other there was a lapse of interest from 1847 until 1884 when Molière (*Lyon Medical*, p. 45, 1884) revived colonic anæsthesia, first with ether vapor forcibly injected. Again another period of disuse from 1884 to 1903 when Cunningham (*Boston Medical and Surgical Journal*, vol. clii, p. 450, 1905) proposed the addition of oil as a vehicle for carrying the vapor into the intestine, perhaps stimulated by Sutton's experience with 140 cases at the Roosevelt Hospital. During the next ten years many surgeons gave colonic anæsthesia a trial and in 1913 Gwathmey presented to the International Medical Congress in London (*Lancet*, December 20, 1913) the results of his observations in the experimental animal of the combination of oil and ether. From these experiments it appeared, regardless of whether one used animal, vegetable or mineral oil, no matter what per cent. the mixture, the rate of evaporation remained constant. The charts of the experimental animal demonstrated quite conclusively that as the ether is evaporated slowly it must be absorbed slowly. The significance of these experimental observations is twofold: in the first place there is an even plane of anæsthesia; secondly, the administration of ether oil colonically is a safe procedure. This, only by way of a very brief introduction.

My first experience with colonic anæsthesia was in April, 1927. On a previous attempt at removal of a deep-seated cerebral tumor, under general ether narcosis, the patient seemed intolerant to ether. Rather against our

* Read before the Philadelphia Academy of Surgery, November 7, 1927.

better judgment ether narcosis was substituted for local anæsthesia, and although there was little in the operative manipulations at that particular sitting to account for it, the pulse rate almost from the beginning was exceedingly rapid and throughout the operation the rate was recorded for the most

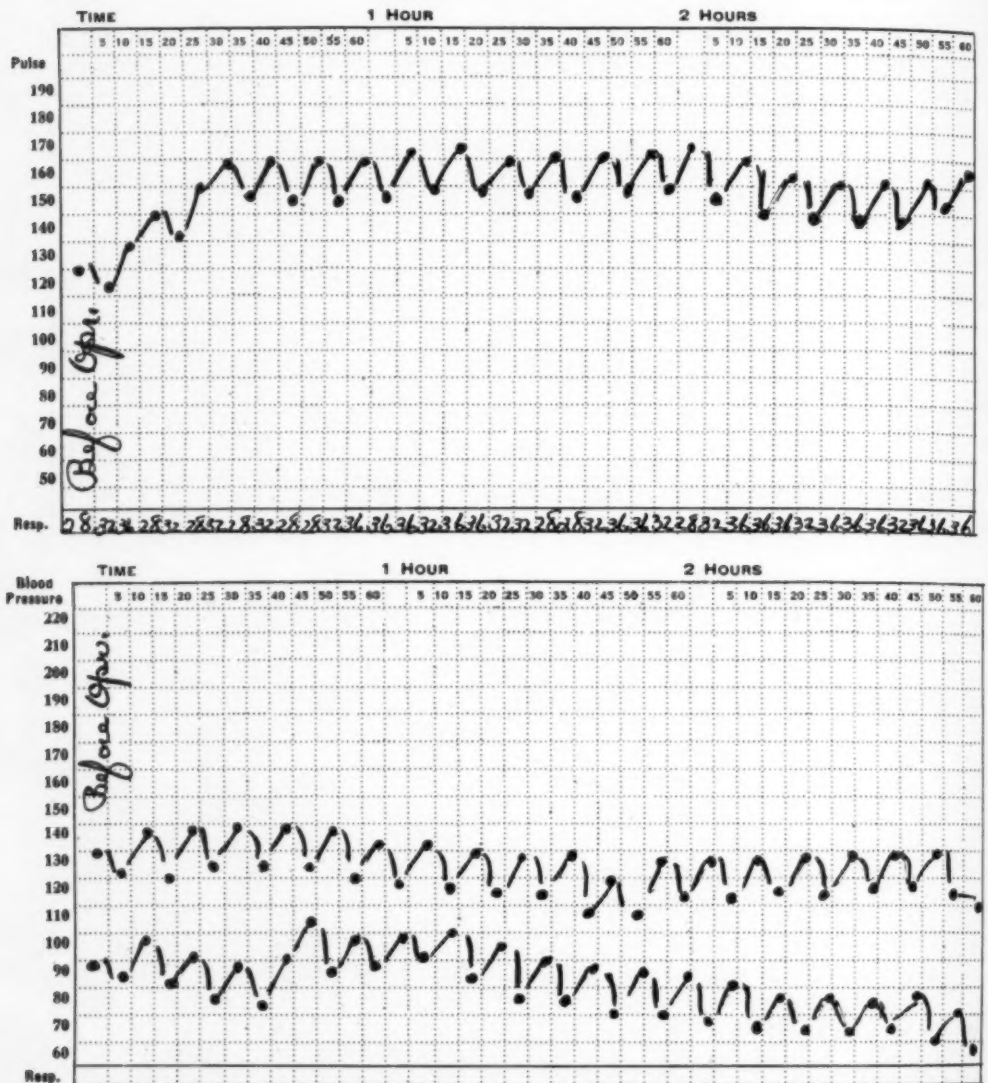


FIG. 1a.—A. H. C. Operation, second stage craniotomy, February 2, 1927. Operator Doctor Frazier. Operation started 9.10 A.M. Operation ended 12.10 P.M. Anæsthetic, local and ether. Open method. Anæsthetizer L. A. Hitz. Total amount used, ether iv oz. A. S. gr. 1/150 B. Anes. Patient fair condition.

part as between 160 and 170. Naturally, I was disturbed and uneasy and when at the next sitting the selection of the anæsthetic was discussed, my anæsthetizer, Miss Leta Hitz, proposed colonic anæsthesia. It was employed with entire satisfaction and if one compares the pulse curves of the two operative sittings (Fig. 1a and Fig. 1b), at once admits a striking demon-

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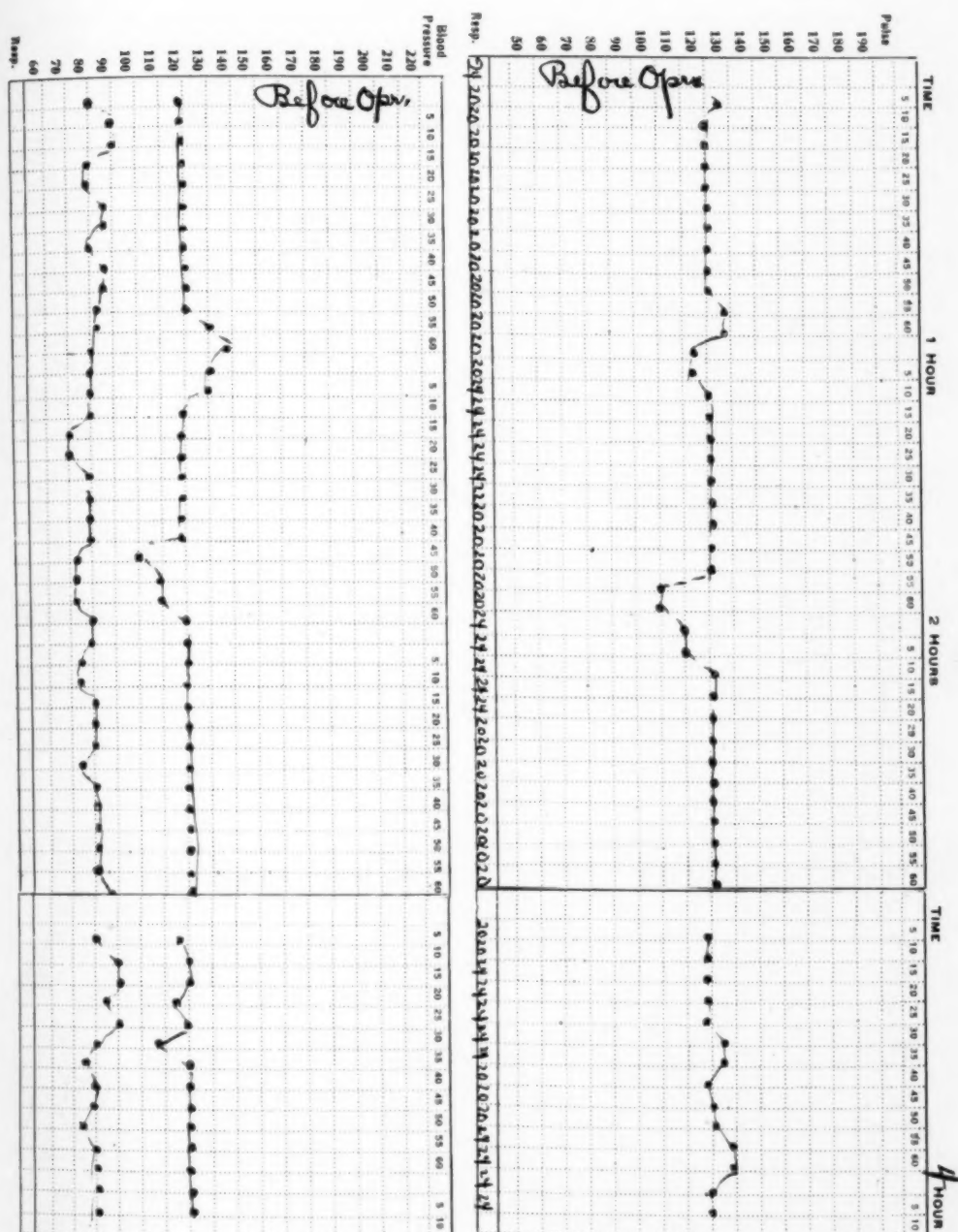


FIG. 1b.—A. H. C. Operation, third stage craniotomy, removal of tumor, April 25, 1927. Operator Doctor Frazier. Anæsthesia started 8.45 A.M. Operation started 9.35 A.M. Operation ended 1.30 P.M. Anæsthesia—colonic. Anæsthetizer L. A. Hitz. Total amount used, ether oz. vi, olive oil oz. iv, 8.45 A.M.—A. S. gr. 1/150, 8.15 A.M. No inhalation anæsthesia. Patient good condition.

stration in favor of colonic over inhalation narcosis. Since this initial experience, colonic anaesthesia has been employed in my clinic seventeen times, in twelve operations by myself and in five operations by my associate, Dr. Francis C. Grant. These operations included for the most part craniotomies with removal of brain tumors, suboccipital craniectomies, subtemporal decompressions, laminectomies.

General Considerations.—It is apparent that colonic anaesthesia by one method or another has had its ups and downs. So far as I know, the application of colonic anaesthesia to operation on the cerebrospinal tract has never been seriously advocated and I must confess were it not for the suggestion and the efficiency of my anaesthetizer, Miss Hitz, I would not have given it a moment's thought. One can readily understand why the abdominal surgeon might have found objection, chiefly in that muscular relaxation was not always adequate, and as this for him is a *sine qua non*, naturally the method fell into disuse. In operations upon the cerebrospinal system, operation requires a state of negative existence, if I may use that term, a negative state of the ego; something which will suppress apprehension, carry the patient through the tedium and the physical discomforts of the fixed position on the operating table for the two or more hours of the neurosurgical operation. It is not analgesia in the ordinary sense that to my mind is the object of the colonic anaesthesia. One can readily desensitize the tissues in all cranial procedures with novocain so that every step of the operation is painless. Neurosurgical operations more than any others lend themselves to local anaesthesia; the easily desensitized scalp, the painless skull, the dura, the brain—it's all a very simple process. You may ask, if one wants only to obtund the mental sensibilities why not use opium or its derivatives? Merely because there are certain recognized contra-indications to morphin in the neurosurgical clinic. In fact, in most instances we regard morphin as taboo. Hence there is a very real need for some therapeutic agency which induces sleep and at the same time depresses neither the circulatory or respiratory mechanism—some agency which will induce a tranquil state. There are patients and patients; in the case of a perfectly phlegmatic subject almost any operation on brain or cord can be carried out under local anaesthesia and, as a matter of fact, the majority of operations in my clinic are carried out with novocain-adrenalin infiltration. But in the case of children, with certain apprehensive women and even some men, we welcome any remedy which will negative their reaction to apprehension or fear and ensure absolute physical rest.

We must recognize such a thing as psychic shock. The emotion of fear is not without its deleterious effect. To cite you an instance: several years ago a physician was about to be transferred to the operating room for a cranial operation. He was exceedingly apprehensive, as many physicians are, and he arrived at the operating room with a systolic blood-pressure of 70 mm. Hg. After the preliminary incision the systolic pressure had not risen and I at once abandoned any thought of continuing the operation and

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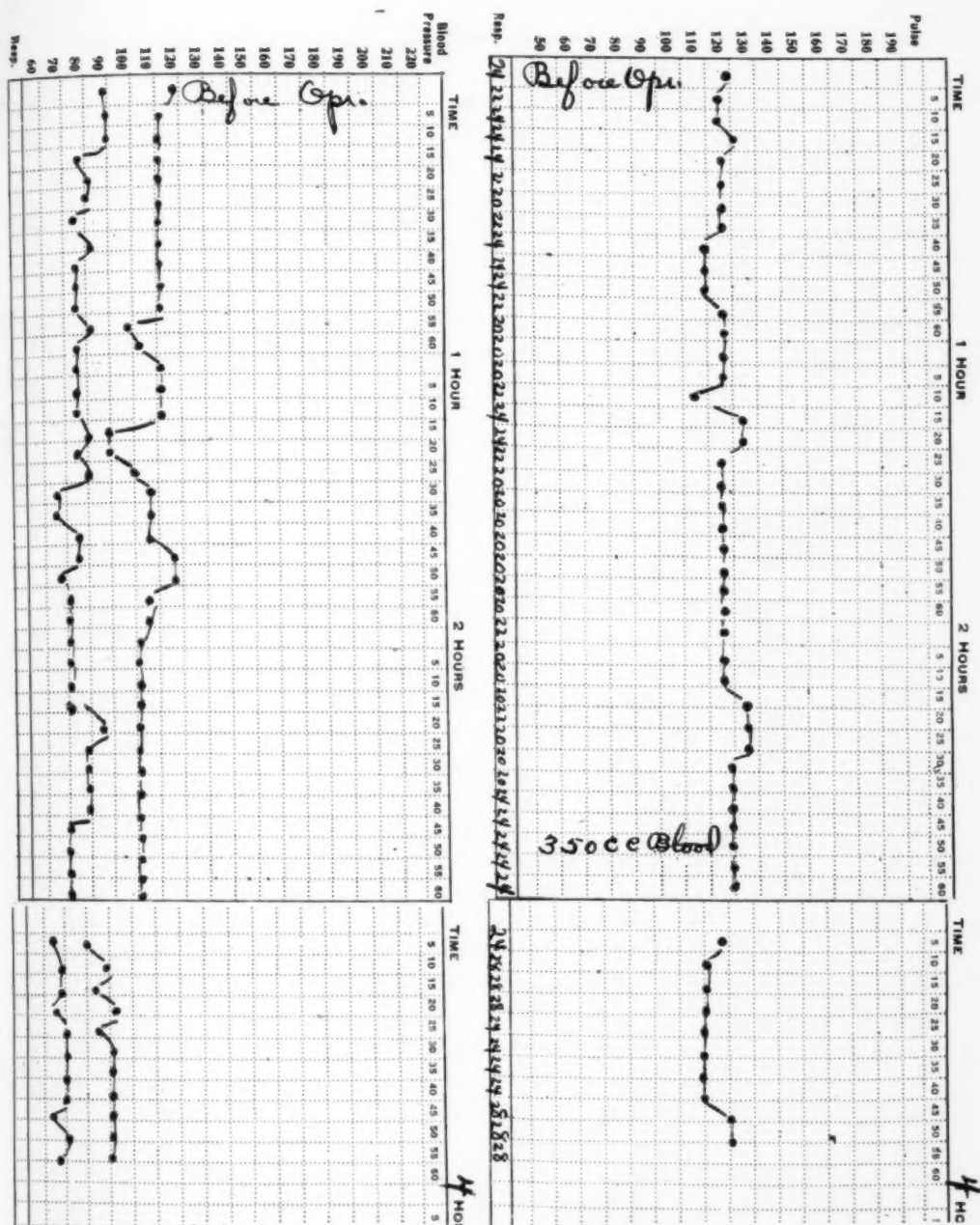


FIG. 2.—Mrs. E. E. P. Operation, right craniotomy, removal of tumor, May 16, 1927. Operator Doctor Frazier. Operation started: 9.20 A.M. Anæsthesia, 8.15 A.M. Operation ended 1.10 P.M. Variety—ether. Method colonic. Anæsthetizer L. A. Hitz. Time to anæsthetize, 1 hour 5 minutes. Amount ether, oz. vi, olive oil, oz. iv, scopolamine gr. 1/200—7.30 A.M., A. S. gr. 1/150. Patient good condition.

sent the patient to his room. It was several days before he reacted. A week later his blood-pressure was normal, his apprehension had been allayed and he passed through the operation without any recurrence of his previous experience.

So many patients in our Neurosurgical Clinic are operated upon in the face-down position, and merely as a matter of convenience, although this is a minor consideration, colonic anaesthesia has its advantages.

I shall not attempt a categorical review of the advantages and disadvantages of colonic anaesthesia. Perhaps of more value and interest would be a brief statement as to my personal reaction.

In the first place, as to its relative safety: we have followed strictly the prescribed dosage and have not seen a suggestion of any toxic effects. There have been a few instances in which it has been necessary to supplement with ether by the inhalation method. Personally, I prefer when necessary, to supplement by inhalation rather than introduce an additional amount into the colon. The latter would be inconvenient while the operation was under way and too much ether introduced into the bowel is not without risk. I think I may say, with entire truth, that at no time in this small series of operations have I had any cause for alarm from the standpoint of anaesthesia. If one wants more specific evidence of the safety of the method, the presentation of the pulse and blood-pressure charts meet the requirements. Here, for example (see Fig. 2) is the chart of a patient past middle life from whom a cerebral tumor was removed. The operation, a craniotomy, lasted almost four hours and you can see at a glance, with a few short and slight variations, how constant the rate of pulse and blood-pressure remained. As an example of an operation in another field, I might exhibit (Fig. 3) the chart of a case in which a cerebellar tumor was removed. As a rule in cerebellar procedures we expect, because of proximity of the brain stem, not only greater fluctuations in pulse and pressure, but marked acceleration in the pulse rate and a decline in systolic pressure as the operation proceeds. In this instance it will be noted the pulse rate was 120 at the beginning, and 120 at the close of a three-hour ordeal, the pressure was 110/80 at the beginning and 110/80 at the conclusion. That in some instances colonic anaesthesia must be supplemented with ether by inhalation is not a very serious objection, although under these circumstances the method does not so nearly approach the ideal. The next chart was made during a suboccipital craniectomy for cerebellar tumor. In this case four ounces of ether were given by inhalation, the pulse rate at the beginning was 125, at the close 110; blood-pressure at the beginning was 120/80 and at the close 120/80 (Fig. 4).

The operation in which, in my experience, colonic anaesthesia seems to have its outstanding indication is laminectomy. It is virtually impossible to complete the operation painlessly under local anaesthesia. Baring the spinous processes is of necessity painful and the manipulations, within the dural sac, with the accompanying traction on the posterior roots, of course excites pain. In my limited series there were several laminectomies and one chart will

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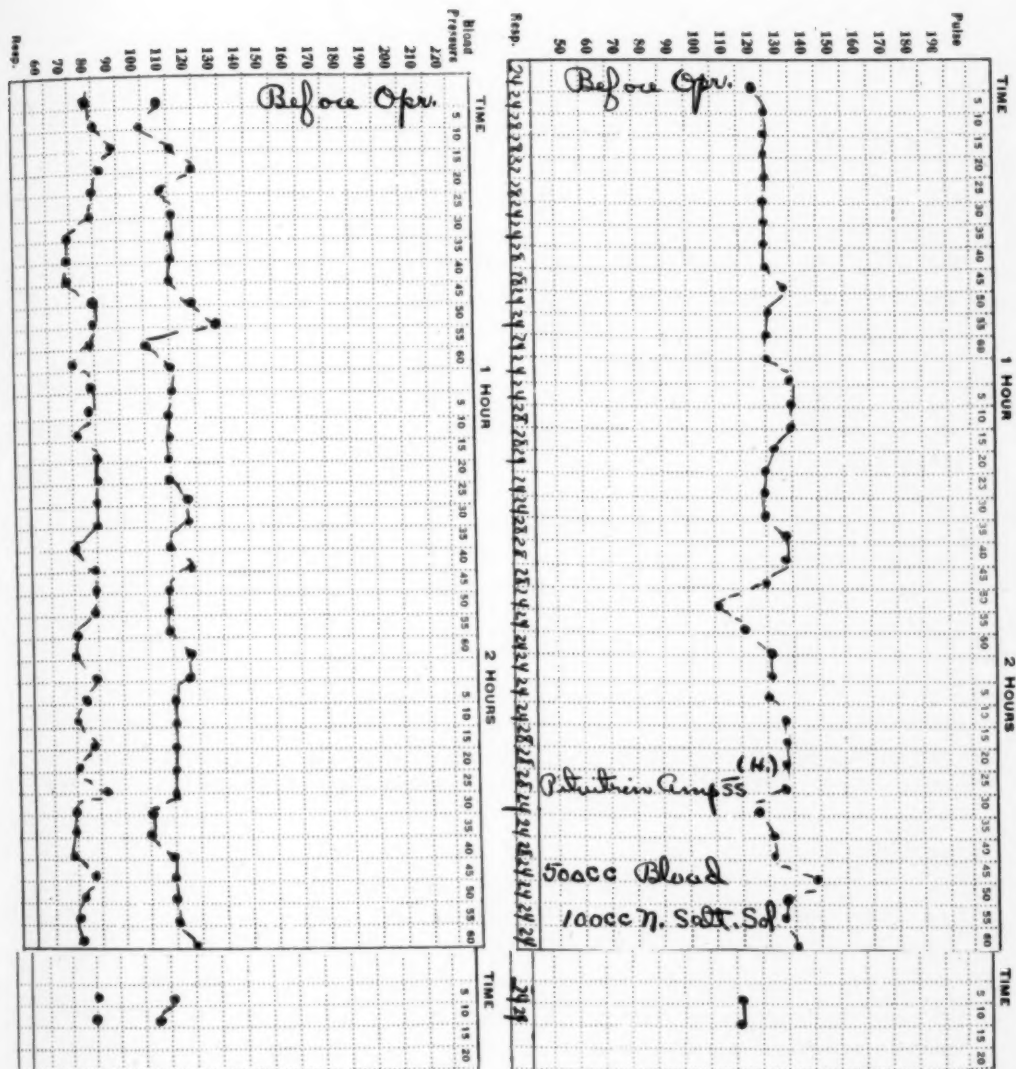


FIG. 3.—N. S. Operation, removal of cerebellar tumor, September 30, 1927. Operator Doctor Frazier. Operation started: anæsthesia 9.40 A.M., operation 10.20 A.M. Operation ended 1.30 P.M. Variety—colonic anæsthesia. Anæsthetizer L. A. Hitz. Inhalation iv. Ether oz. vii, olive oil oz. iv, scopolamine gr. 1/200, 8.10 A.M. Patient good condition.

suffice by way of illustration. The subject was a patient past middle age, who was not altogether a good operative subject. (Fig. 5.) Before the wound was finally closed four hours elapsed, but at no time did the patient's condition give us the slightest cause for anxiety. Six ounces of ether were introduced into the colon and toward the close of the operation four ounces were given by inhalation. Pulse and blood-pressure curves speak for themselves.

From the standpoint of the comfort of the patient, the unpleasant sense of suffocation that often accompanies ether inhalation is avoided. The patient is in an analgesic state for several hours after the operation and post-operative pain is thereby prevented. Furthermore, post-operative nausea is reduced to a negligible degree.

Post-operative pneumonia after operations upon the brain is with us so rare a complication that it cannot be used as a criterion to judge of the advantages of colonic over inhalation anæsthesia. But emphasis might be laid on the fact that in colonic anæsthesia the patient always inhales a warm moist vapor. In its passage through the small vessels of the colon, through the liver and heart to the lungs, the ether is moistened and warmed to body temperature so that in the induction of anæsthesia and in its maintenance, there is no irritation of the upper air passages and bronchi and no resulting secretions. This absence of irritation suggests an advantage of colonic over inhalation anæsthesia in patients with pulmonary tuberculosis and as a matter of fact in the second case of our series colonic anæsthesia was given preference for this reason. The fact that ether can be absorbed by the colon only at a fixed rate, about two ounces per hour, is another factor of safety. Anæsthesia is automatically maintained, according to Gwathmy, because there is a constant rate of ether evaporation from the oil, regulated by the temperature of the colon; the cooling of both the mixtures and gut during evaporation retards both elimination and absorption. Again the difference between the ether absorption power of the colon and the elimination capacity of the lungs provides another safety factor.

Thus in colonic anæsthesia we have a method of inducing narcosis in which there is none of the sense of suffocation, no period of excitement, no harmful influence upon pulse or blood-pressure, no irritation of the upper air passages, a state of analgesia after consciousness has returned, a narcosis of uniform depth, the ether vapor is always warm, there is less post-operative nausea and vomiting, the amount of ether in the system is a fixed known quantity.

The technic of administration as adopted by Miss Hitz is as follows:

Castor oil fluid ounce I on two successive nights preceding the operation.

Luminal grains I on the night before operation.

Soap and enema followed by a colonic irrigation on the morning of operation.

One hour before the operation the patient is sent to the etherizing room, where absolute quiet must be observed, and is given by bowel two drachms of

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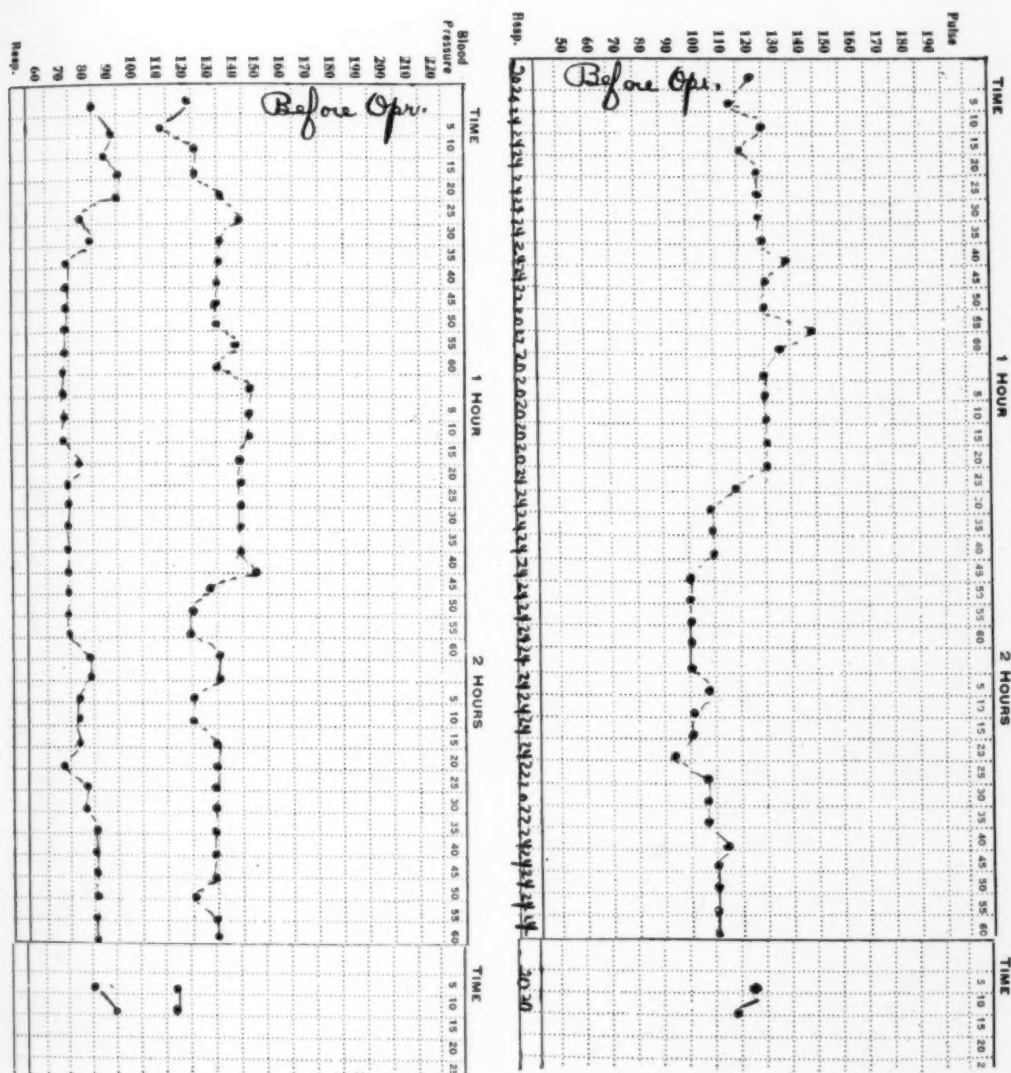


FIG. 4.—E. C. Operation, suboccipital craniectomy, September 17, 1927. Operator Doctor Frazier. Operation started: anæsthesia 8.10 A.M., operation 9.30 A.M. Operation ended 12.40 P.M. Variety—colonic anæsthesia. Anæsthetizer L. A. Hitz. Amount inhalation ether oz. iv, 8.10. Ether viii oz., oil iv oz., scopolamine gr. 1/100. Patient good condition.

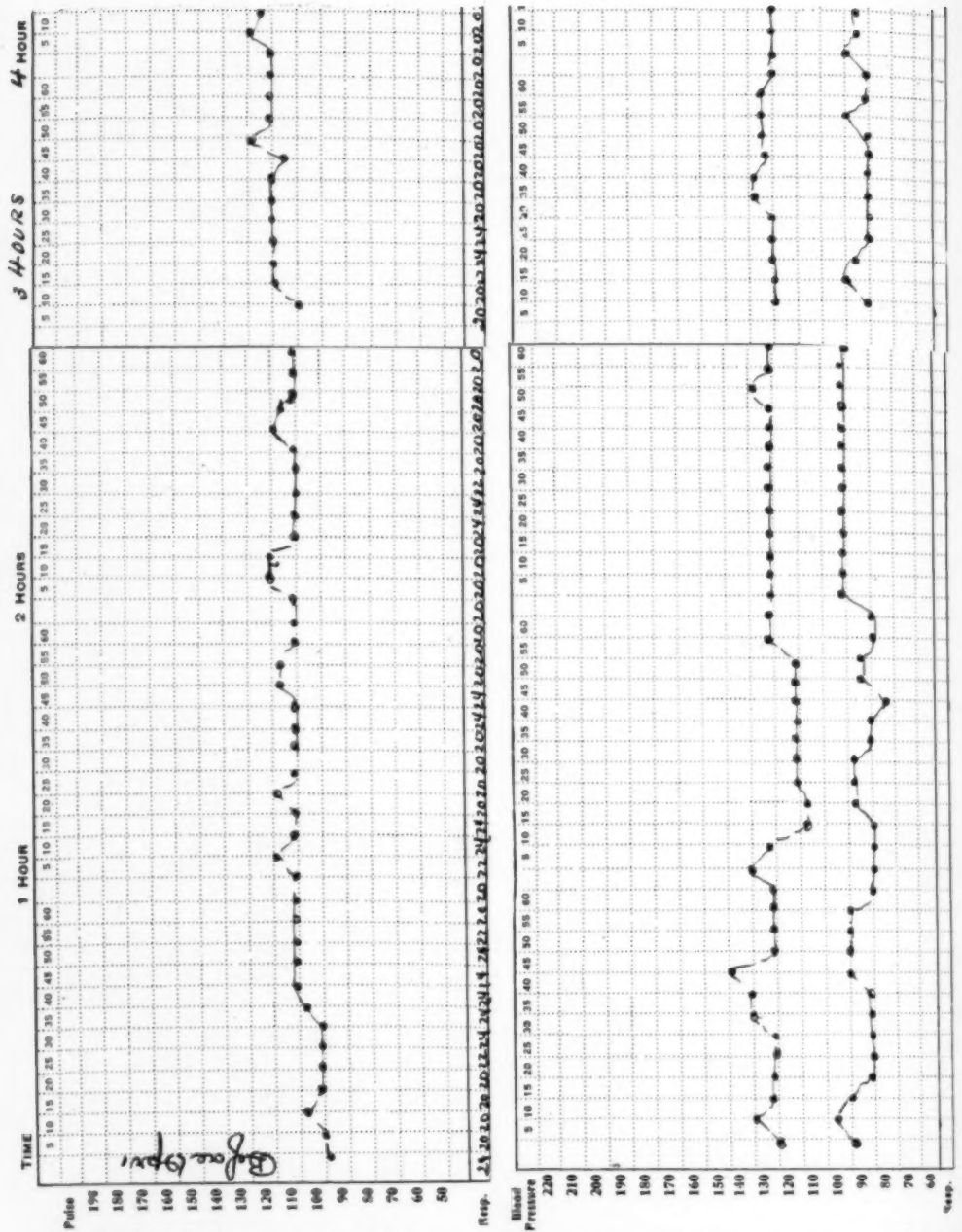


FIG. 5.—K. McK. Operation, laminectomy, tumor exposed but not removed, June 23, 1927. Operator Doctor Frazier. Operation started: anesthesia 8.00 A.M., operation 9.00 A.M. Operation ended 12.30 P.M. Variety—colonic anesthesia. Anesthetizer L. A. Hitz. Inhalation oz. vi. ether, oz. iv olive oil, Pituitrin amp. ss., M. S. gr. 1/4, A. S. gr. 1/150. 7.30 A.M. Patient good condition.

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paraldehyde, one-half ounce each of olive oil and ether in which five grains of chloretone have been dissolved. This mixture is introduced very slowly, the rectal tube is clamped for a few moments, then withdrawn.

One-half hour before the time set for the operation, unless contra-indicated, morphine grains one-sixth and atropin grains $1/150$ th are given hypodermatically and at the same time the balance of the ether-oil mixture. With the patient on his left side, one fluid ounce of a 65 per cent. solution of ether in olive oil for every 20 pounds of body weight is allowed to flow slowly from a funnel into the rectal tube. This amount, however, should not exceed eight fluid ounces. The rectal tube is clamped and left *in situ*.

At the conclusion of the operation what remains of the mixture in the bowel is drained off, and after irrigating the bowel with one pint of warm water, four ounces of olive oil with from four to eight ounces of black coffee are introduced and the rectal tube withdrawn.

Care must be taken during the operation to see that the mouth and nose are in no way obstructed so that breathing is not impeded.

In the case of children no preliminary treatment is required save atropin and the amount of ether should not exceed one fluid ounce per twenty pounds of body weight.

DIFFERENTIAL SECTION OF THE TRIGEMINAL ROOT IN THE SURGICAL TREATMENT OF TRIGEMINAL NEURALGIA¹

By BYRON STOOKEY, M.D.

OF NEW YORK, N. Y.

IN THE development of the surgical treatment of any disease the principle of evolution with its additions, subtractions, trial and error is not infrequently seen, usually with a constant trend toward greater specialization in the procedures used. Archaic methods, however, remnants of a former

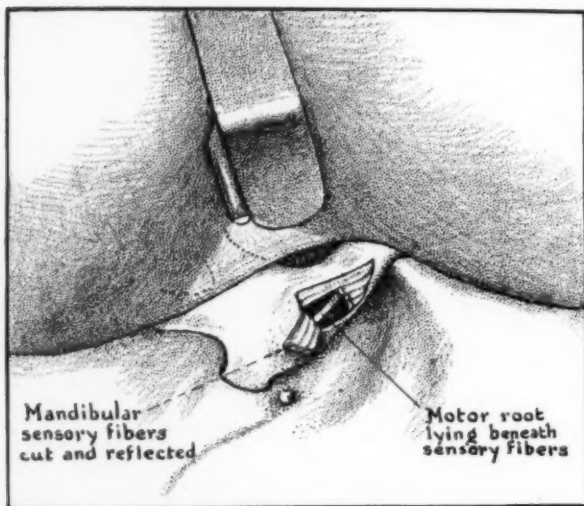


FIG. 1.—Differential section of the trigeminal neuralgia limited to the mandibular division. The sensory fibres of the dorsal root derived from the mandibular division are cut without cutting the maxillary or ophthalmic fibres. The motor root lying beneath the sensory root is identified and saved.

age, are frequently adhered to by the profession at large, long after they have been proved obsolete by those working more intensively in the particular field. Section of the nerves within the skull distal to the gasserian ganglion, operations on the peripheral branches, alcoholization of the gasserian ganglion, and of the branches, and total section of the trigeminal roots, both motor and sensory, are among such archaic methods, though

there are exceptional instances when some of these procedures may still be indicated.

In the evolution of the surgical treatment of trigeminal neuralgia there have been a number of refinements of procedure, the most important of which was the substitution of complete section of the dorsal root for the older procedure of removal of the gasserian ganglion—an advance suggested by Spiller and first carried out by Frazier. The method suggested by Spiller was generally adopted in this country until further refinements in the procedure were developed by Dr. Charles Frazier, who saved first the motor division, while cutting all of the sensory root, and later saved not only the motor division but the ophthalmic fibres of the sensory root as well. A still further refinement in the surgical treatment of trigeminal neuralgia was

¹ Read before the New York Surgical Society, December 14, 1927.

SURGICAL TREATMENT OF TRIGEMINAL NEURALGIA

presented sometime ago by the writer² before the New York State Medical Society, Section on Surgery and Neurology, namely, *differential section* of the dorsal root, those fibres within the dorsal root derived from the mandibular division being selected for section when the pain occurs in the domain of the mandibular nerve, and those from the maxillary division for pain in the domain of the maxillary, the remaining fibres being left intact.

Frequently tic douloureux remains limited to the mandibular division for many years before spreading to the maxillary or the ophthalmic division. In differential section fibres derived from the mandibular nerve within the dorsal root are differentiated and cut, leaving the patient with a relatively limited area of anæsthesia and yet free of pain. In cases with pain limited to one division, differential section of the fibres from that division the writer feels is of distinct advantage, a more conservative procedure, and a further desirable refinement of technic, since the destruction of sensory fibres is reduced to a minimum, with complete relief of pain.

In view of these refinements of technic, it does not seem justifiable to treat trigeminal neuralgia in an expectant manner, since, so far as we know no means of permanent relief has been found other than section of the fibres carrying the pain impulses. Once the diagnosis is definitely established, surgical intervention is indicated.

Alcoholization of the nerve trunks, commonly employed in the treatment of trigeminal neuralgia, is an archaic procedure developed at the time when removal of the gasserian ganglion was the only operative means of relief offered. This operation, even in the most skilled hands, had a mortality rate of approximately 14 per cent., and trophic disturbances of the eye were a common sequela. Naturally, under such circumstances any procedure giving relief was preferred to operation. Since then, however, a complete revolution in the operative procedure of trigeminal neuralgia has taken place. The mortality rate has been reduced to less than 1 per cent., local anæsthesia is used as suggested by Alfred S. Taylor, and refinement of technic has made it pos-

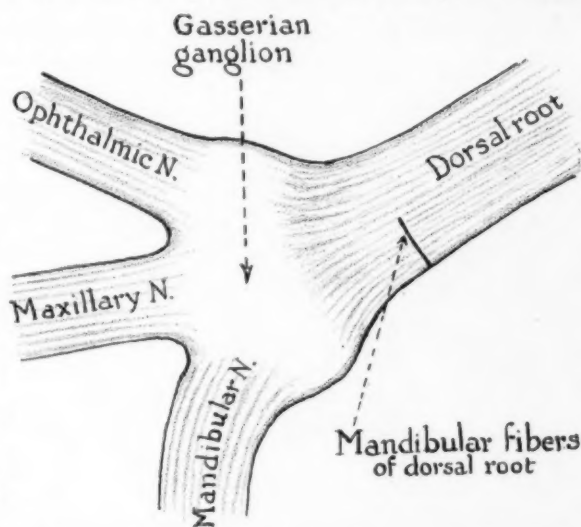


FIG. 2.—Schematic drawing of the gasserian ganglion and dorsal trigeminal root. Line of section to cut the sensory fibres derived from the mandibular division.

² Differential Section of the Trigeminal Root in the Surgical Treatment of Trigeminal Neuralgia, New York State Society, New York City, March, 1926.

sible to secure permanent and complete relief of pain with the production of a minimum anæsthetic area. Alcohol injection, on the other hand, is an extremely painful procedure and gives only temporary relief. Operation must eventually be done, frequently after the patient is considerably older and the operative risk greater. The invariable query of patients who, after a series of alcohol injections, have come at length to differential section, is: "Why did I not have an operation in the first place and spare myself the torture of repeated alcohol injections?"

The injection of alcohol into the nerve trunk is furthermore not without danger, since occasionally the arachnoid sheath covering the nerve may descend an unusual length along the nerve trunk and alcohol consequently be injected into the subarachnoid space. For similar reasons injection of

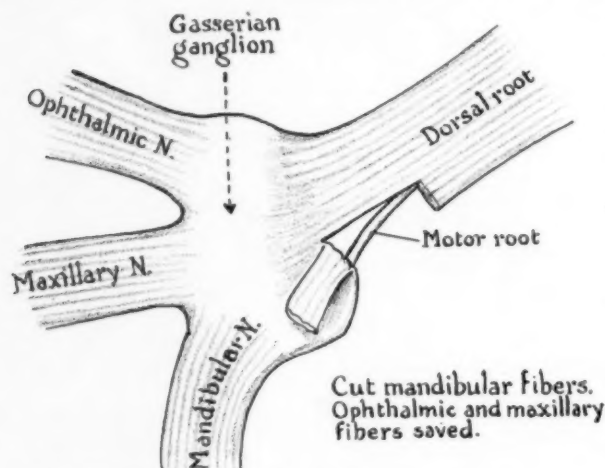


FIG. 3.—Same as 2 with mandibular division cut and reflected showing the motor root passing diagonally beneath the sensory root. The motor root is saved.

alcohol into the gasserian ganglion is dangerous. Since the gasserian ganglion is surrounded by the arachnoid membrane alcohol may be injected into the subarachnoid space and along the dorsal root into the basal cysterne. Alcoholization of the ganglion should, therefore, be condemned. An unfortunate case in which alcohol injection into the gasserian ganglion was followed by nearly complete paralysis of all of the cranial nerves on both sides has been reported. While it is true that such untoward complications are rare, they are pointed out as evidence that alcohol injection in itself is not altogether as harmless as is generally believed. Alcohol injections should not be used as a routine procedure in the treatment of trigeminal neuralgia, but should be reserved for those special cases in which there is doubt as to the diagnosis, or in which operation of any kind is contra-indicated because of the patient's general condition, or because of some disturbance in vision on the affected side, etc.

Neuralgia in the ophthalmic division is extremely uncommon, occurring in less than 5 per cent. of those afflicted with trigeminal neuralgia. Where there is pain referred over the ophthalmic division, this is frequently found to have originated in the maxillary division, radiating secondarily in the ophthalmic area. To classify such cases as neuralgia of the maxillary and ophthalmic divisions is inaccurate and misleading. They are properly called primary maxillary neuralgia with secondary ophthalmic neuralgia, and are

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to be distinguished from the rare cases of primary pain in the ophthalmic distribution. If this distinction is made, cases of ophthalmic neuralgia are found to be even rarer than the figures given above would indicate.

That pain in the ophthalmic division is frequently an overflow phenomena rather than true primary pain is suggested by the fact that injection of alcohol into the second division may relieve not only the pain in the second division, but also that referred along the ophthalmic division; similarly injection of the mandibular division may relieve secondary or referred pain in the maxillary division. While relief of secondary pain may not be experienced if the pain is of long duration, in cases seen early, before the secondary pain impulses have become permanently fixed, complete relief is usually obtained by treating the division primarily involved.

These observations have had an important bearing in pointing the way toward differential section of the dorsal root. In several patients in whom pain occurred primarily in the maxillary division, radiating later into the ophthalmic and mandibular divisions, the ophthalmic has been deliberately spared when section of the dorsal root was done, with relief of all pain. Thus even in some cases of so-called ophthalmic neuralgia, section of the maxillo-mandibular division has given complete relief. The ophthalmic division should be cut only when it is the primary

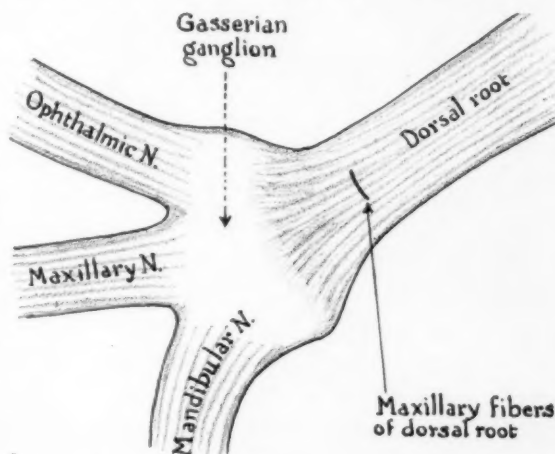


FIG. 4.—Line of section to cut the sensory fibres derived from the maxillary division.

source of the pain. It is thus extremely important to distinguish between the primary and secondary ophthalmic neuralgias, that the ophthalmic division may be saved in all cases except those showing primary involvement of this part of the trigeminal nerve. This is a new conception and is as yet in the experimental stage. It may well be that those in whom this distinction has been made may have recurrence of pain in years to come. Time and further experience alone will tell. One patient, indeed, has had recurrence of pain though in this instance there was some doubt as to whether the ophthalmic pain was primary or secondary. It is my practice to explain the situation to the patient and to the physician by whom he is referred, so that the possibility of recurring pain may be fully appreciated.

Usually a second operation in an old operative field presents special difficulties, but such is not the case with differential section of the trigeminal root. The line of cleavage between the dura and the bone is as readily followed at the second operation as at the first, and bleeding is less, since the

foramen spinosum is already plugged and a dry field is usually assured. Identification of the gasserian ganglion and the dorsal root offers no special difficulty. Since a second operation is as easy or easier than the first, a conservative attitude can be more readily adopted; an obvious advantage.

Abundant comparative anatomical and embryological evidence is at hand to indicate the separateness of the ophthalmic nerve from the maxillo-mandibular nerve. The trigeminal nerve is in reality two nerves—the ophthalmic and maxillo-mandibular, which become fused into one. In the lower animals the ophthalmic develops as a separate nerve having its own ganglion and distinct peripheral and central connections. It develops in front of the second myotome while the maxillo-mandibular rises caudal to the second myotome. Later the ganglion

of the ophthalmic nerve fuses with the maxillo-mandibular ganglion and the central connections to the brain stem join those of the maxillo-mandibular to enter the brain stem as a common dorsal root. Further evidence of the separateness of these two nerves is seen within the brain-stem, where the central arms of the ophthalmic and maxillo-mandibular nerves are found as two separate bundles in the descending trigeminal tract, the ophthalmic lying more ventral and the maxillo-mandibular more dorsal.

FIG. 5.—Area of anæsthesia after total section of the trigeminal root.

Human embryological evidence, as pointed out by Giglio Tos (1902)³ and Frazier and Whitehead (1926)⁴ show that the adult gasserian ganglion develops as two separate ganglia, one for the ophthalmic and another for the maxillo-mandibular divisions.

Thus both comparative anatomy and embryology furnish an undeniable basis for the view that the trigeminal nerve is really made up of two nerves, one the ophthalmic and the other the maxillo-mandibular, having had at one



FIG. 6.—Area of anæsthesia after differential section of the trigeminal root for pain limited to the mandibular division (see figure 1).

³ Tos, Giglio: Sull' origine embrionale del nervo trigemino nell' uomo. *Anat. Anzeiger*, vol. xxi, 1902.

⁴ Brain: Vol. xlviii, p. 458, 1926.

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time in their phylogeny separate ganglia, separate dorsal roots, separate entrances, and a separate course within the brain-stem. With such a foundation, one feels more secure in treating trigeminal neuralgia, not as a unit involving the whole of the adult trigeminal nerve, but as affecting two entities brought together only in their grosser morphology yet retaining their individuality in their clinical manifestations. As often happens, phylogenetic studies point the way to clinical understanding and to more rational and specialized surgery.

In view of such studies and of the clinical observations referred to earlier in this paper, the conservative treatment outlined is felt to be justifiable. As has been mentioned, the profession is greatly indebted to Dr. Charles Frazier for suggesting first that the motor root be saved, and second, that the ophthalmic division be saved in those cases in which the pain is limited to the maxillo-mandibular divisions. This operation Doctor Frazier has designated as "subtotal resection".

A further step in advance, the writer believes, is marked by the suggestion presented some time ago, before the New York State Medical Society, namely that in those patients having so-called ophthalmic neuralgia a distinction be made between primary and secondary ophthalmic pain and that the ophthalmic fibres of the dorsal root be cut only in those in whom the pain in that division is primary. As a still further refinement in the surgical treatment of trigeminal neuralgia, it was suggested that the dorsal root fibres central to the ganglion derived from the mandibular be cut when the mandibular division is the source of pain, or the maxillary when the maxillary is the source of the pain. This procedure which the writer has termed "differential section" has been found valuable by the additional experience since gained. Thus by differential section only those fibres central to the ganglion are destroyed which carry the pain impulses. As yet a sharp line of separation between the maxillary and the mandibular divisions within the dorsal root has not always been possible. An overlap of one or two funiculi is likely to occur at the line of section. With further experience, however, it seems probable that more accurate separation of these funiculi will be possible, and that *differential section of the dorsal root* will find increasing application.



FIG. 7.—Photograph of patient showing area of anaesthesia after differential section of the dorsal trigeminal root. The fibres within the dorsal root derived from the mandibular division were cut for major trigeminal neuralgia with the pain limited to the mandibular division. The sensory fibres from the ophthalmic and maxillary division have been saved as well as the motor root.

CONCLUSIONS

(1) A distinction should be made between primary and secondary or referred neuralgia of the ophthalmic, the maxillary or the mandibular divisions. In early cases of primary neuralgia of the ophthalmic, maxillary or mandibular divisions section of the fibres in the dorsal trigeminal root derived from the division along which the pain impulses are carried, should be done without section of the remaining fibres. In long-standing cases distinction between primary and secondary neuralgia of the various divisions cannot always be made and section of the fibres from two divisions may be necessary, hence early diagnosis and surgical treatment is advisable as soon as the diagnosis is definitely established.

(2) *Differential section* is a further refinement in the surgical treatment of trigeminal neuralgia which has proven a satisfactory procedure in the cases done since the writer's first report was made before the New York State Medical Society in 1926.

(3) By *differential section* is meant section of the fibres within the dorsal root central to the ganglion derived from the division producing the pain without section of the remaining fibres. If the pain is in the mandibular division, the mandibular fibres central to the ganglion are cut without cutting the maxillary or ophthalmic fibres. If the pain is in the maxillary these fibres are cut without injury to the mandibular or ophthalmic fibres. If the pain is in the ophthalmic alone without involvement of the maxillary or mandibular, the ophthalmic fibres are cut.

(4) By *differential section* the fibres are differentiated along which the pain impulses are carried and these only are cut. Thus both the anæsthetic area and the attendant paræsthesias are reduced to a minimum.

THE RELIEF OF PAIN IN CARCINOMA OF THE FACE *

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MUCH has been written concerning the treatment of cancer of the face and jaws while but little has been done for the relief of pain in this distressing disease. Persistent pain is a common complaint, particularly in the incurable cases. Many of these patients have ulcerating infected lesions which are extremely sensitive even if they suffer no spontaneous pain, and treatment whether operative or by radiation is frequently painful. Moreover, the period of convalescence is often uncomfortable on account of post-operative infection, painful dressings, radium irritation and the like. Blocking the trigeminal nerve will give relief from all of these discomforts in some cases, and marked alleviation for months in a large proportion of the rest. Thus much needless suffering is saved.

One of us¹ has already reported a number of cases in which this procedure has been tried and these cases are included in the group on which this communication is based.

Section or blocking of the fifth nerve can only be used to stop pain caused by lesions within the distribution of that nerve. In this connection we must remember that these patients frequently have two forms of pain—pain from the original growth and that caused by metastases in the neck. The pain from the metastases is commonly much less severe and there may be no complaint of it at first, on account of the more severe pain from the original lesion. But when the major pain is relieved the less severe may come to the surface and cause some complaint. Under these conditions it may become necessary to sever intradurally the posterior roots from the three upper cervical segments as suggested by Fay,² or section the glossopharyngeal within the cranium as described by Adson.³ Furthermore, it frequently happens that cancer of the pharynx, tonsils or of the deeper nasal sinuses will cause pain which is referred to the face. Unfortunately, this pain cannot be relieved by blocking of the fifth nerve.

The sensory supply of the face and mouth is not as simple as might be supposed from a perusal of the standard anatomies. The trigeminal fibres ramify to the external surface of the face approximately from the level of the line of the lower jaw anterior to the external auditory meatus upward

* Read before the American Surgical Association, May, 1927.

to the vertex of the scalp. Within the mouth and nose the mucous membrane lining the cheek, the inferior and superior maxillæ, the hard palate and the lateral and superior surfaces of the anterior two-thirds of the tongue,



FIG. 1.—Sensory distribution first, second, third divisions of fifth nerve on the skin surface of the face.

together with the anterior half of the nasal septum and turbinates, receive sensory fibres from this source (Fig. 1). But about the periphery of this sensory supply there are definite overlaps from adjacent nerves; the upper cervical nerves below along the line of the mandible in front of the ear and in the floor of the mouth and the glossopharyngeal in the posterior part of the tongue, tonsillar pillars, soft palate, and naso-pharynx. The facial nerve apparently only carries pressure pain sensibility fibres,⁴ although even this is denied by other observers.⁵ The part played by the sympathetic chains in conveying sensation is less

clearly understood. Nor are we more certain of the sensory supply of the accessory nasal sinuses. The mucosa of the frontal and maxillary sinuses probably receives most of its sensory enervation from the first and second divisions of the fifth respectively, possibly in combination with sympathetic fibres from the sphenopalatine ganglion, but the pathways from the sphenoid and ethmoid cells are less perfectly understood.

It will be evident that a malignant growth involving the posterior and upper nasal sinuses, the tonsillar ring, deeper portions of the floor of the mouth, the pharynx and the ear will not give nearly as satisfactory results following blocking of the fifth nerve as those lesions which are situated in the distribution of that nerve alone. It is essential, therefore, to select the cases carefully with a clear picture of the trigeminal sensory distribution in mind. For although in some of the lesions situated in the areas having a double nerve supply, partial relief may be obtained, but nevertheless the results will not be entirely satisfactory.

Various forms of nerve blocking can be used, including posterior root



FIG. 2.—The shaded area showed the distribution of post-operative anæsthesia to touch, pain, and temperature over the tongue, hard palate and anterior part of the soft palate on the right in a case of trifacial neuralgia. After J. B. Doyle, *Arch. Neurol. and Psych.*, 1923, vol. ix, p. 34.

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TABLE I.

Table Showing Location of Growth, Type of Treatment and Results. Note That the Least Satisfactory Results Were Obtained Where the Floor of the Mouth Was Involved.

Location of growth	No. of cases	Treatment	Result
Maxillary antrum and upper jaw	23	Alcohol injection, 2nd Div. 9 cases 14 cases	Pain relieved 5. Pain not relieved 4, no anes. obt'd.
Pain relieved	13	3rd Div. 2 cases	Pain relieved 2.
Pain partially relieved	4	2nd and 3rd divisions, 3 cases	Pain relieved 2.
Pain not relieved	4		Pain 60% relieved 1.
Died	2	Intracran. Neur. 2nd and 3rd Div. 4 cases	Pain 75% relieved 3.
		Avulsion Sens. rt. 5 cases	Died, 1. Pain relieved 4. Died, 1.
Post ethmoid cells and maximum antrum	2	Avulsion Sens. rt. 2 cases	Pain 60% relieved 1. Pain relieved 1.
Pain relieved	1		
Pain partially relieved	1		
Cheek—skin	7	Alcohol injection, 2nd Div., 2 cases 3 cases 2nd and 3rd Div. 1	Pain relieved 1. Pain not relieved 1.
Pain relieved	6		Pain relieved 1.
Pain not relieved	1	Intracran. Neur., 2nd and 3rd Div. 2 cases	Pain relieved 2.
		Avulsion sens. rt. 2 cases	Pain relieved 2.
Cheek—Mucous membrane	1	Alcohol injection, 2nd Div. 1 case	Pain 60% relieved 1.
Partially relieved	1		
Tongue	7	Alcohol injection, 3rd Div. Inf. dental and lingual nerves 7 cases	Pain relieved 5.
Pain relieved	6		Pain partially relieved 1.
Pain partially relieved	1	1st and 3rd Div.	Pain relieved 1.
Inferior maxilla	10	Alcohol injection, 3rd Div. 7 10 cases	Pain relieved 6. Pain 75% relieved 1.
Pain relieved	7	Inf. dental and lingual nerves 2	Pain 60% relieved 2.
Pain partially relieved	3	2nd and 3rd Divs. 1	Pain relieved 1.
Tongue and floor of mouth	12	Alcohol injection, 3rd Div. 9 cases	Pain 50% relieved 2. Pain relieved 1.
Pain relieved	1		Pain not rel'd 6.
Pain partially relieved	7	Avulsion sens. rt. 3 cases	Pain 75% relieved 1.
Pain not relieved	3		Pain not rel'd 1.
Died	1		Died 1.

section, intracranial neurectomy of the second and third divisions and alcohol injection of these branches peripherally. We have not used peripheral neurectomy or injection of the Gasserian ganglion with alcohol. While these procedures may have a place in the control of pain from new growths, we have felt that the methods we have used would be more satisfactory.

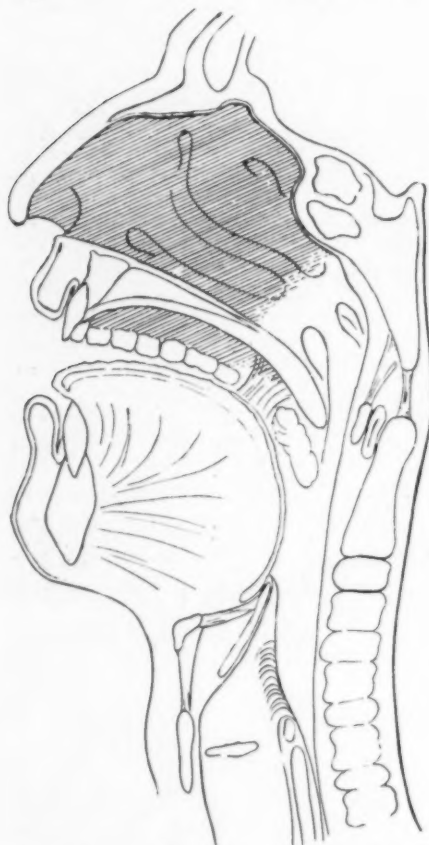


FIG. 3.—The shaded area shows the distribution of post-operative anæsthesia to touch, pain, and temperature over the lateral wall of the nasal cavity, hard palate, and anterior part of the soft palate on the right in a case of trifacial neuralgia. After J. B. Doyle, *Arch. Neurol. and Psych.*, 1923, vol. ix, p. 34.

We feel that the method of choice in handling a case of carcinoma of the upper or lower jaw, buccal mucous membrane or antrum where pain is or probably will be a factor, is intracranial section of the second and third divisions and plugging the foramina through which they pass with bone wax as a preliminary to treatment of the new growth. By preserving the first division all possibility of trophic eye complications is avoided. This method is applicable to cases in which the lesion is in the distribution of the second and third divisions and in which treatment by surgery or radium may be expected to prolong life. This operation is not a difficult one—not as difficult in fact as cutting these divisions outside the skull. Where there is any contra-indication to the use of a general anæsthetic it may be performed with infiltration by novocaine. In several instances we have tied the external carotid as a first step. This makes the neurectomy easier and is of considerable advantage to the surgeon who is to handle the treatment of the

new growth, particularly if he wishes to perform an excision. In some instances the neurectomy has been immediately followed by excision with the cautery knife and in others the excision has been postponed. No anæsthesia is needed for the excision except a little novocaine toward the median line, or back on the soft palate. The patient is conscious throughout the operation, can keep his pharynx and trachea clear of blood and mucous, and post-operative dressings are painless. If radium is used there is no pain from radium irritation as so often occurs. If the growth involves the floor or the contents of the orbit, upper part of the nose or the forehead, a posterior root section, rather than intracranial neurectomy should be performed,

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as section of the first division any great distance back of the supra-orbital notch is impracticable.

We may occasionally see one of these cases where the growth is so situated that an alcohol injection is sufficient to permit the necessary surgical procedures to be performed and give a painless convalescence. In our experience, however, this has been the exception and not the rule. Naturally, if this minor procedure is all that is necessary, the more formidable operation should not be considered.

In case of doubt as to the possibility of relief of pain by intracranial section on account of the situation of the new growth, or on account of metastasis outside the distribution of the trigeminal nerve, a preliminary injection with alcohol or novocaine of the second and third divisions of the fifth nerve may be given. If pain is relieved to a sufficient extent to make intracranial section worth while, the operation can be performed at once or, if desired, when the pain recurs. It should be remembered in this connection that the situation of the new growth may be the determining factor in favor of intracranial section. If a radical removal is to be performed later, it is unwise to go through diseased tissue to block the nerve with alcohol. Moreover, there may be sufficient distortion of the position of the nerve due to the growth to make it difficult to inject it accurately with alcohol.

The greater number of these patients have been sent to us for the relief of intractable pain, late in the course of the disease, after surgical measures and application of radium for the control of the process have already been tried. Some of them have had extensive ulcerative growths, some painful septic wounds, while others have been suffering from the distress which follows the application of radium in some form or other. In this group further treatment of the growth can at best be only palliative. The presence of extensive metastases or direct extension of the new growth outside the distribution of the trigeminal nerve complicates the picture and should not be overlooked. For this reason we feel that in these advanced cases alcoholic injection of the appropriate trigeminal division should be first attempted. If the resulting anæsthesia indicates a successful injection, and if the pain is not relieved, further procedures directed against the fifth nerve are useless. Cervical rhizotomy or section of the glosso-pharyngeal may be necessary,

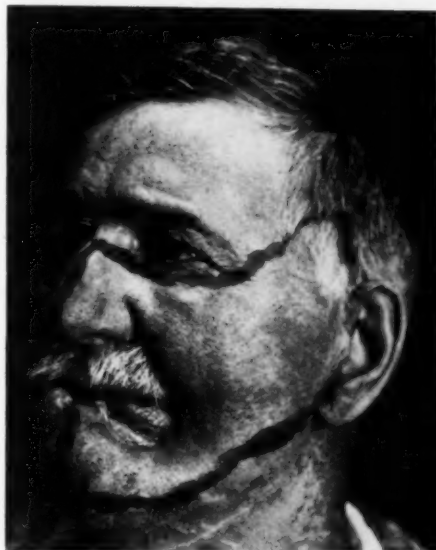


FIG. 4.—Case of carcinoma of jaw and cheek. Intracranial neurectomy—second and third divisions of fifth nerve. Note area of anæsthesia.

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measures which are not included in the scope of this article. The relief of pain in these late cases is often most striking, but by this time these sufferers are in poor condition and frequently drug addicts. Even if their pain is completely relieved they are still incapacitated and unable to take up any occupation.

In two instances where pain persisted after blocking the fifth nerve, injection of the sphenopalatine ganglion has been performed for us by

TABLE II.

Brief Resumé of Results.

	Relief	Partial relief	Failure	Dead
Intracranial operations, 18.....	12	5	1	3
Deep injections, 44.....	25	8	11	0
Superficial injections, 3.....	0	3	0	0

Removal of growth without anæsthetic after treatment 7 cases

Dr. V. H. Kazanjian, with definite, though only partial, relief. This injection should be considered in all cases of new growth involving the region of the posterior nares or upper nasal sinuses where blocking the trigeminal nerve is only partially successful in relieving pain.

CONCLUSIONS

We feel that any patient suffering severe pain from a neoplasm, wholly or in large part, within the distribution of the trigeminal nerve, may be greatly relieved by blocking or sectioning this nerve or some of its branches.

That not only can pain from the new growth be relieved, but the suffering caused by the various forms of treatment used for this disease can be ameliorated.

That the patient's general condition can be improved in many instances on account of increased ability to take nourishment.

That the method of choice in suitable cases is intracranial section and that this procedure should be carried out prior to treatment of the new growth if pain is or probably will be severe.

That alcoholic injection has a definite place in the control of pain, particularly in advanced cases.

We wish to express our thanks to the members of the Department of Röntgenology of the Hospital of the University of Pennsylvania, of the Department of Röntgenology and Tumor Clinic of the Massachusetts General Hospital and to the Staff of the Huntington Memorial Hospital for their interest and help in this work. These cases have all been seen through the kindness of these gentlemen and they have been of great help to us in formu-

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lating our ideas. In several instances they have postponed direct attack upon the new growth until after we have endeavored to render the area involved painless.

REFERENCES

- ¹ Grant, F. C.: *ANNALS OF SURGERY*, vol. lxxxix, No. 2, February, 1925; *Journal A. M. A.*, vol. lxxxvi, pp. 173-175, January 16, 1926.
- ² *Surg., Gynec. and Obstetrics*, vol. xliii, No. 3, September, 1926.
- ³ *Arch. Neuro. and Psycho.*, vol. xii, No. 5, November, 1924.
- ⁴ Davis, L. E.: *Arch. Neurol. and Psych.*, vol. ix, No. 3, March, 1923.
- ⁵ Mills, C. K.: *Journal Nervous and Mental Dis.*, vol. xxxvii, p. 273, 1910.

BRANCHIAL ANOMALIES AND NEOPLASMS

A REPORT OF THIRTY-TWO CASES WITH FOLLOW-UP RESULTS

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THE branchial anomalies are the so-called branchial cysts and fistulas, cervical and auricular appendages, fistula auris congenita and a neoplasm supposed to arise from vestigial remnants, branchial epithelioma. As the late results of operative treatment have been reported only in relatively few instances, we have included this information in regard to our own cases presented in some detail in the appended synopses.

Before and after Hunczowski's¹ report in 1789 of what was subsequently believed to be branchial fistula, a host of writers described various swellings and fistulas in the neck under as many names. These periods yielded very little accurate scientific data, although some of the symptoms and signs of branchial anomalies were given clearly. The initial descriptions of these conditions were followed by other contributions in French, German, Latin and English, including those by Dzondi,² Asherson,³ Heusinger,⁴ Fisher,⁵ Cusset,⁶ von Volkman,⁷ Senn,⁸ Quénu,⁹ Richard,¹⁰ Hahne,¹¹ Gussenbauer,¹² Sultan,¹³ Perez,¹⁴ Veau,¹⁵ Whitacre,¹⁶ and Siegel.¹⁷ After 1880, the clinical manifestations of branchial anomalies were familiar to many, but the literature was full of varied discussion on their embryology and pathology. The origin of these lesions in some vestigial remnant of the branchial apparatus or the thymo-pharyngeal duct leads us to a consideration of the various suggestions that have been made.

Embryological Hypotheses. 1. *The Branchial Cleft Hypothesis.*—Rathke,¹⁸ in 1828, first described the branchial clefts in animals and humans. Sutton,¹⁹ Fig. 1, and Cusset,⁶ Fig. 2, concluded that there were in embryos of lower animals five branchial arches separated by five clefts and that if any of the lower clefts were not obliterated by the growth of the corresponding arch an abnormality such as branchial fistula would result. These observers assumed that the condition in the human embryo is analogous and that branchial fistulas can occur at levels corresponding to the various unobliterated clefts. Whether or not this assumption is correct, clinical observation has shown that the internal opening in complete fistula always occurs in the supratonsillar fossa (von Kostanecki and von Mielecki²⁰), which corresponds with the second cleft, as will be explained later. The next hypothesis was evolved in order to explain this phenomenon.

2. *Rabl's Hypothesis.*—Rabl²¹ pointed out that in the early embryo there

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are four branchial bars numbered consecutively from above down. Each is a protrusion with an ectodermal furrow above and below. These furrows do not normally communicate with the entodermal furrow which springs from the pharynx. The subsequent development of the mesoderm in the pouches and its circular segmentation produce the branchial arches. The two sides of the first, or mandibular arch, meet to form the mandible. The second, or hyoid arch (Fig. 3), grows rapidly downward and in front, invading the entire future cervical region. A recess, known as the precervical sinus (Fig. 3), which develops from the overgrowth of the second branchial arch accompanied by the atrophy and posterior displacement of the two arches below, is practically obliterated. The potential space which occurs from the apposition of ectoderm against ectoderm is obliterated by a disintegration of its cells. The furrow beneath the second branchial arch, which is very deep at its posterior end, persists longer than the other transitory conditions. The future site of the tonsil is at the internal invagination of the entoderm and is on the same level as the second furrow. Normally, in a mammal, there is no such final communication at this point between ectoderm and entoderm as exists in fish, where such communications produce the gill cleft. The third and fourth furrows gradually become stretched out and flattened, the third becoming the thymus. The fourth is separated from the entoderm by a very thick layer of mesoderm and a break into the precervical sinus at this point is scarcely probable. It is accordingly evident that the level of the second furrow is the logical point at which a fistula may enter into the pharynx.

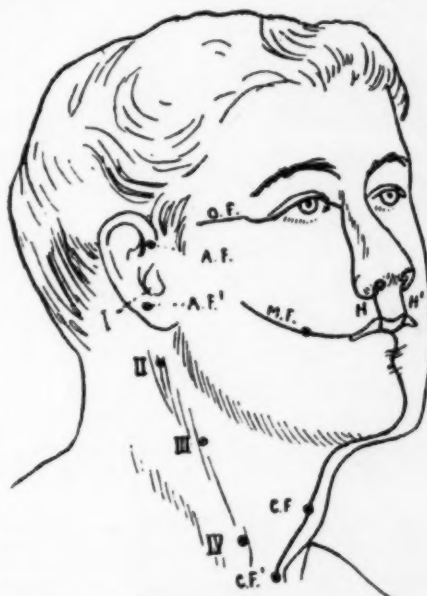


FIG. 1.—Sites of branchial cleft anomalies according to Sutton¹⁸.

All the following types of branchial abnormalities become readily understandable:

a. The external opening may be high or low in the neck, depending on the downward extent of the growth of the second branchial arch (hyoid arch). In no case would it be above the structures derived from the hyoid arch or below the sternoclavicular junction. The invagination or evagination of the arch determines the external opening with respect to the midline.

b. The blind end of an incomplete external fistula is a continuation of the vestigial remains of the ectoderm of the precervical sinus.

c. If the second arch obliterates the precervical sinus, but the second

furrow persists and communicates with the pharyngeal entoderm, an incomplete internal fistula results.

d. A cessation of complete downward growth of the second arch, accompanied by a break through the mesoderm at the level of the second furrow, will produce a complete branchial fistula.

e. If both internal and external openings are lacking and the precervical sinus has not been completely obliterated, a branchial cyst will result.

Figure 3 illustrates how an irregular development of the second arch results in a continuance of the precervical sinus which is normally obliterated.

This produces various abnormalities, ranging from fistulas and cysts to monstrosities.

3. Wenglowski's Hypothesis.—

Wenglowski²² contends that branchial anomalies can occur only above the hyoid bone and that the thymo-pharyngeal duct is the anlage for cysts and fistulas below the hyoid. In embryos of about 6 mm. the thymus appears as an entodermal evagination from the ventral part of the third branchial groove on both sides. This evagination communicates with the pharynx by a tract in its centre, the thymo-pharyngeal duct, which later becomes obliterated and,



FIG. 2.—Sites of branchial cleft anomalies according to Cusset²¹. He thought that there were seven clefts and that the fourth gave rise to most of the anomalies.

in embryos of 14 mm., loses its connection with the parent epithelium. From the pharyngeal pouch the thymo-pharyngeal duct passes caudally, laterad and dorsally; it then makes an angle to course caudally, mesially and anteriorly over the superior portion of the thyroid gland, subsequently, about the sixth week of fetal life, to reach the supracardiac area in the substance of the thymus (Fig. 4). At the same time the duct becomes obliterated in its upper part and the remainder is an epithelial-lined tract which, near the pharynx, is characterized by ciliated columnar epithelium. Lymphoid-like cells are found beneath the epithelium. By these observations Wenglowski explains how cysts and fistulas may arise from the thymo-pharyngeal duct.

It would seem that there are several points which this theory does not explain. Branchial structures may occur altogether above the hyoid bone and above the jaw, and it would be difficult to explain the constant occurrence of lymphoid tissue, presumed by Wenglowski to come from the thymus, in the walls of fistulas and cysts in these locations. It would also be difficult to explain the inconstant position of the external openings of fistulas and the relatively high locations of most branchial cysts.

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4. *Frazer's Hypothesis*.—Frazer²³ presents the possibility that branchial rests may not come from the precervical sinus but rather from the "placodal cysts" or ducts, or from the ectodermal "external pharyngeal ducts" which are connected with the entodermal pouches. There might also be abnormal fusion between the sides of the second groove in some part of its extent. Frazer has also shown how embryologically the hypoglossal nerve might come into relation with branchial cysts.

Branchial Cysts.—

There were twenty of these in this group. They have been referred to under a variety of names, among them "sequestration dermoids".²⁴

Although it has been taken for granted generally that they occur only

in the branchial areas, Coakley²⁵ reported a case in which the tumor apparently sprang from the nasopharynx and Fredet and Chevassu²⁶ spoke of an intraparotid branchial cyst. Whether or not the condition in Coakley's

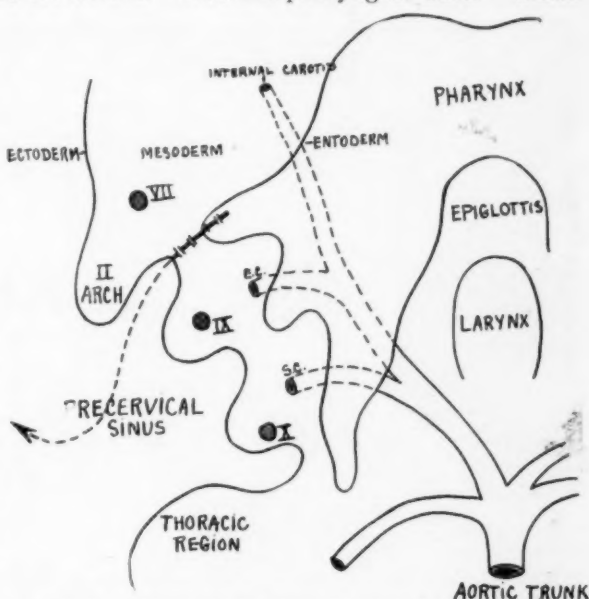


FIG. 3.—Embryo of mole (schematic cross-section, after Rabl²¹) showing the predominant second arch, the precervical sinus and the path of a complete branchial fistula (---) with the break through the mesoderm into the pharynx (—). (Drawn by Dr. J. Alonzo.)

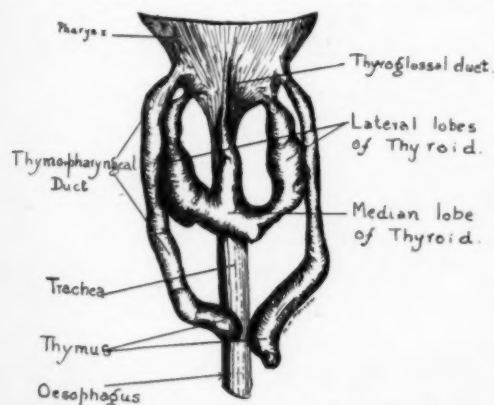


FIG. 4.—Model of part of 14 mm. embryo to show the thymo-pharyngeal duct and its relations (after Wenglowski²²).

patient might have been a cystic tumor of the hypophyseopharyngeal duct is open to question. A familial tendency has been recorded only by Carwardine²⁷ who reported a branchial "dermoid" in a woman whose mother had "a small cervical tubercle." This patient had accessory abnormalities: a branchial cervical tubercle and an additional antitragus on the same side.

In this series they all had a stratified squamous epithelial lining and all had masses of lymphoid tissue with well-developed germinal centres averaging 1 mm. in thickness in the fibrous tissue outside of the epithelial lining (Fig. 7). This serves to distinguish them from thyroglossal

cysts and fistulas which practically never have lymphoid tissue in the wall. McFarland²⁸ says that there may be stratified columnar ciliated epithelium lining parts of some cysts. Virchow²⁹ observed a cartilaginous plaque in the

wall of one cyst. Where infection had occurred, part of the epithelial lining was replaced by granulation tissue. The cyst wall was usually about 1 mm. thick (Fig. 6), but if there had been long-standing inflammation it might be as much as a centimetre in thickness due to fibrosis; with inflammation it was customary to find one or more enlarged lymph-nodes in close approximation to the cyst wall.

From an analysis of these cases it appears that they occurred most frequently in the third

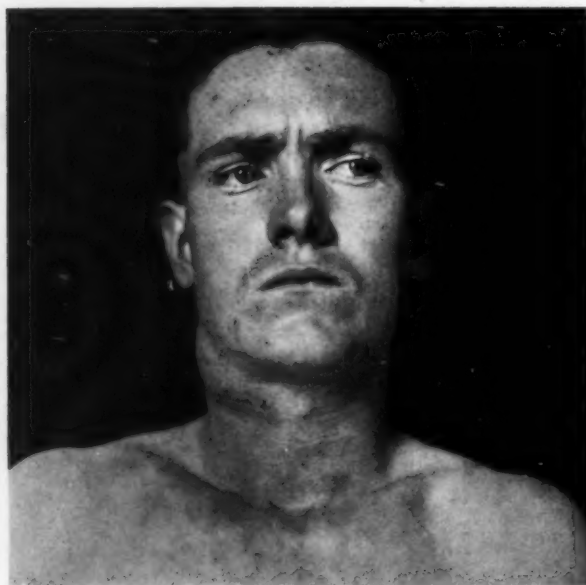


FIG. 5.—Photograph of patient with branchial cyst (case history No. 21507). Note the high position of the swelling in the sternomastoid region.

decade, although infancy and old age were not exempt. Females were preponderant in a proportion of two to one. In the majority of cases the anomaly was found on the left side. Occupation seemed to have no importance as an etiological factor. As a rule, the swellings of the cysts gradually increased in size, but some diminished and increased alternately. Occasionally their size was stationary for a long time and then suddenly became larger. The average duration of the swelling before relief was sought was about one year. Most of the cysts were located beneath and anterior to the sternomastoid just below the mandible. Some were small, others large, the average diameter being about 5 cm. The majority were encapsulated and fluctuant or cystic. About half



FIG. 6.—Photograph of excised cyst after it had been opened, hardened and the contents evacuated. (Case history No. 43364).

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were movable and the others were loosely attached to the deeper structures. Skin reaction was the exception. A cold or sore throat frequently preceded their appearance or increase in size. Pain was unusual and when present occurred locally in a mild degree or only on swallowing. Infection of the cyst had some effect in the production of this last symptom. Several cysts, which had been erroneously incised before admission to the hospital, continued to drain. At operation, the anatomical location of the cysts was studied with especial reference to their relations with the great vessels (Fig. 8). Eighty-five per cent. extended down to them and the remainder were either superficial or passed from the surface deep to them. In this series one prolongation of the cyst wall ran to the "base of the skull" and another

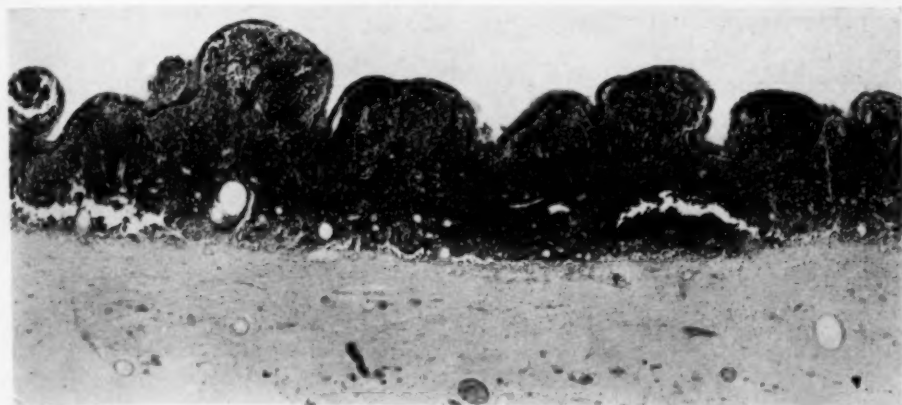


FIG. 7.—Microphotograph of cross-section of cyst wall showing stratified squamous epithelial lining and external to it the lymphoid tissue and the fibrous tissue wall (case history No. 56966).

to the parotid region. Bailey³⁰ described a fourth variety which is between the vessels and the pharyngeal wall. The contents of the cysts was thick amber to turbid or purulent fluid or pale necrotic material resembling caseation necrosis. This fluid may contain epithelial cells or their degeneration products, cholesterol crystals. The close resemblance of cysts to cold abscesses originating in cervical lymph-glands resulted in this incorrect diagnosis in half of our cases. The same error was made in the six cases reported by Bailey³⁰ and in cases reported by Johnson³¹ and by McKenty.³² In this connection, it is interesting to note that about half of our cases had swelling of surrounding lymph-glands. Complications that may occur are fistula formation, a superimposed epithelioma, or infection of the cyst with subsequent spontaneous or traumatic rupture of the overlying skin.

The chief clinical diagnostic problem is the differentiation of these cysts from tuberculous adenitis with or without abscess formation. A single cystic painless movable and non-tender swelling, gradually increasing in size and found in the upper half or third of the sternomastoid region is very apt to be a branchial cyst. A solitary broken-down tuberculous abscess, not associated with other much enlarged tuberculous glands, simulates this closely. In tuberculosis the overlying skin is more often a dull red, there is closer

attachment to surrounding structures and if a röntgenogram shows calcification the diagnosis is practically assured. If cholesterol crystals are found in the aspirated contents, an epithelial-lined cyst may be suspected. Other conditions for differential diagnosis, mentioned by Bailey,³⁰ are cavernous hemangioma and lymphangioma, aneurism, lipoma, thyroglossal cyst, chronic retropharyngeal abscess and a degenerated malignant neoplasm.

Treatment consisted in complete excision of the cyst wall and in the late results in fourteen of our cases there were no recurrences.

Branchial Fistulas.—There were four of these studied in this group. The fistulas like the cysts were squamous epithelium and had wall (Fig. 9). In addition columnar epithelium parts of the tracts epithelium were some-same section. We did but, as many ob-ported them, we felt have been destroyed and sectioning of the In one case there accessory tracts or with simi-lium adja-main tract. glands, re-the ones in of the ton-found close of the tract pharyngeal complete

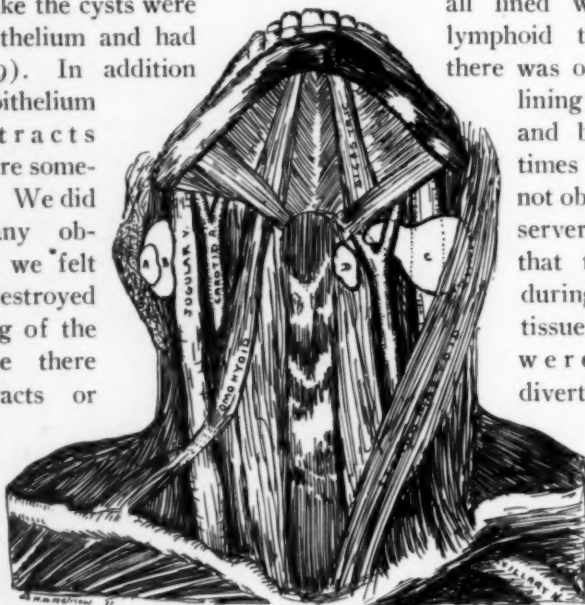


FIG. 8.—Schematic drawing to show the various possible positions of branchial cysts with respect to the great vessels. A. The superficial type. B. The type which is preponderant. The cyst extends down to the great vessels. C. The type which extends from the superficial tissues down between the external and internal carotid arteries. D. The type described by Bailey³⁰ which is deep to the great vessels and near the pharyngeal wall.

Heusinger³³ observed cartilage in the wall of a fistula. They were all congenital, but a very small external opening which did not discharge caused some of them to be overlooked. It is generally believed that they are more frequent in females and that they are found in the majority of cases on the left side. A familial tendency was first reported by Asherson,³ and Tilley³⁴ mentioned four members in a family of eight who had branchial fistulas. Fischer³⁵ found hereditary influence in 21 out of 100 collected cases. One of our cases had a bilateral branchial fistula and her father, paternal grandfather, brother and female cousin on her father's side all have bilateral cervical fistulas. Another brother had a proven branchial appendage.

Fistulas have been divided into: 1. External complete—those with only an outer opening. 2. Internal incomplete—those with only an inner opening. 3. Complete—those with an internal and external opening.

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The external openings have been usually pinhead in size and located, as a rule, along the anterior border of the sternomastoid below the level of the thyroid cartilage. They have varied in size and position, occurring even above the mandible as reported by Virchow.³⁶ When occurring in the midline, the diagnosis of thyroglossal fistula must be eliminated. In all of our cases the external openings eventually developed swellings around them. Discharge from the opening was sometimes delayed several years and sometimes initiated by some respiratory infection. It varied in character from thin and watery to mucoid or purulent. The presence of hair in the tract has been reported.³⁷

In one of our cases a chronic unproductive cough was stopped promptly by excision of the incomplete external fistulous tract. At operation it was found adherent to the vagus. The clinical relation of branchial fistula to irritation of the vagus and glossopharyngeal nerves has been discussed in a previous communication by one of us.³⁸

The tract was usually felt partly in the subcutaneous tissues and on dissection it was found to pass backward in the direction of the pharynx, coming into relation with the carotid sheath or the internal and external carotid arteries, or possibly the ninth, tenth or twelfth cranial nerves, or the digastric muscle. Its pharyngeal end was usually thin and friable. The inner opening of a complete fistula has always been reported in the supratonsillar fossa and it was there in our cases. In one of these it was first noticed after a tonsillectomy. Kramer³⁷ also has reported this. A foul and profuse discharge into the pharynx speaks strongly for the presence of an inner opening. This opening has been demonstrated by successful probing of the tract, the injection of a colored or bitter solution through the



FIG. 9.—Microphotograph of branchial fistula near its pharyngeal end showing stratified columnar epithelium lining it, a lymph follicle in the wall and surrounding it striated muscle. In the lumen is blood and epithelial debris. (Case history No. 69188).

external opening which appears in the pharynx, or by actual visualization of the opening in the pharynx. The tract has been shown in the röntgenogram when injected with an opaque substance.

The treatment of all fistulas has been surgical and success has depended upon a complete excision of the tract. Von Hacker³⁹ described the best method of dealing with the inner end of complete fistulas after dissection had been made as far back as possible, by inversion into the pharynx. This

has also been carried out by Gross,⁴⁰ Meyer,⁴¹ Lilienthal⁴² and Douglas.⁴³

That complete removal of the tract will prevent a recurrence has been demonstrated by the late results of all the cases of this series.

Cervical and Auricular Appendages and Fistula Auris Congenita.—The appendages, of which there were four in this series, are congenital and usually occur in front of the tragus or concha of the ear, or in the anterior cervical region (Fig. 10). The branchial appendages are soft nipple-shaped protuberances covered by hair-bearing skin. They are held erect by a



FIG. 10.—Photograph of cervical appendage.
(Case history No. 37556).

central bar composed of any of the three types of cartilage (Fig. 11), giving a sensation of firmness on deep palpation. They may increase in size and at operation the cartilage was found superficial to the fascia. Their complete removal prevents any recurrence. Siemens⁴⁴ and also Guszman⁴⁵ have described them at length. The latter found that preauricular appendages occur mostly on one side. In an examination of 11,000 people they were found bilaterally only once. In the neck they occur less frequently, have been found in several members of one family and in association with other abnormalities (Ferran.⁴⁶) Klausner⁴⁷ have described them in animals. Clarke⁴⁸ has seen cervical appendages proved microscopically in the goat and pig. There was a familial tendency in these animals.

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Fistula auris congenita is frequently seen and has been described by Hahne,¹¹ Hamann,⁴⁹ and Stammers.⁵⁰ The last reports six cases of pre-auricular fistulas originating in two different families. His opinion is that they do not originate in the branchial apparatus but in an aberrant coalescence of the six tubercles destined to form the pinna. It is generally conceded, however, that they are branchial in origin. At times they discharge a turbid or purulent fluid. An excision of the fistula will show it to end blindly in the subcutaneous tissue or parotid fascia.

Branchial Epithelioma.—Von Volkman,⁵¹ in 1882, was the first to describe

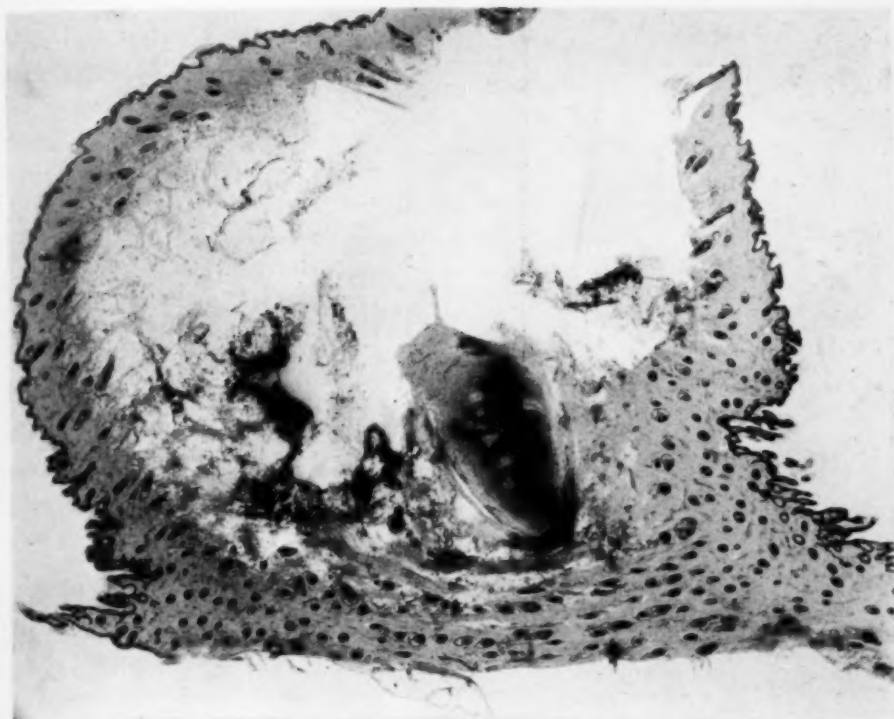


FIG. 11.—Microphotograph of oblique section through appendage shown in figure 10 showing the cartilaginous plaque in the centre. Many hair follicles are shown in the skin.

this condition in man. Other contributors have been Leboeuf,⁵² Zicas,⁵³ Brünet,⁵⁴ Veau,¹⁵ Siegel,¹⁷ Perez¹⁴ and Lorenz.⁵⁵ They have also been described in the dog⁵⁶ and the horse.⁵⁷

Malignant epithelial neoplasms apparently arising from branchial epithelium are relatively rare in our experience at the Presbyterian Hospital. During a ten-year period, from January 1, 1915, through December 31, 1924, approximately 3961 neoplasms of all kinds were observed; 1538 of these were cancers and only four of these were thought to have had a branchial origin. It is possible that some of the branchial epithelial neoplasms that have been reported as such may have had some tiny overlooked primary

focus in the mouth, pharynx, larynx, sinuses, œsophagus or some distant site. McKenty,³² Richardson,⁵⁸ Brandt,⁵⁹ and Hudson⁶⁰ stress the significance of this point. Even an autopsy may not be conclusive.

As Ewing⁶¹ reiterates, these are ramifying cystic growths with squamous epithelial cells forming the lining of the cysts and infiltrating the surrounding tissues. In addition we found with Johnson and Lawrence⁶² that the epithelial lining of these cysts often formed papillary projections into the

lumens (Fig. 13). All four of the neoplasms which we are reporting conformed to this type. In no reported case, nor in these present cases is there scientific proof of an origin from branchial epithelium. The absence of a discoverable primary focus and the distinctive gross and histological features are strong presumptive evidence of a probable common origin in branchial cleft epithelium.

All our cases were in males above the age of forty. In cases which Veau¹⁵ collected from the literature, he found forty-seven males to one female, and Siegel¹⁷ agrees in the great preponderance of the condition in the male sex. Hudson⁶⁰ has emphasized that most of these patients are employed in a dust-laden atmosphere and three of our cases come in this group. The swelling comes on gradually or very rapidly and occasionally a patient states that it diminishes in size. It is usually situated

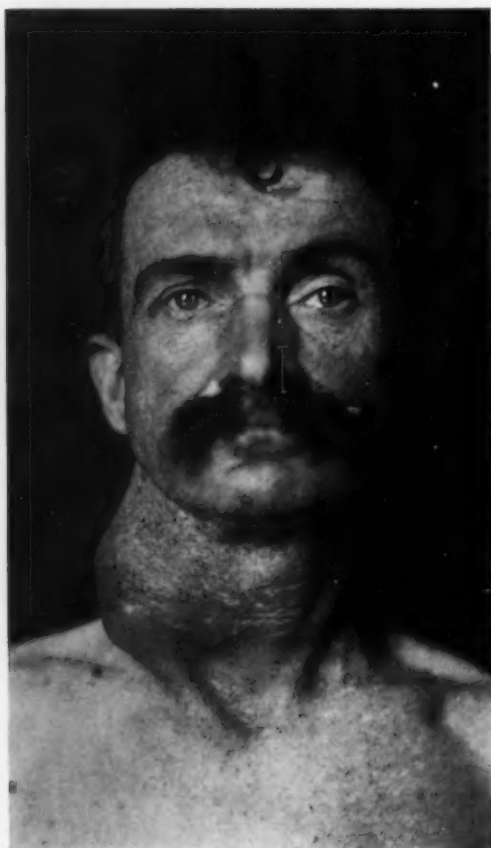


FIG. 12.—Photograph of tumor produced by branchial epithelioma. It was adherent to all surrounding structures, the surface was coarsely nodular, hard and fluctuant in the lower portion. (Case history No. 35740).

about the middle third of the sternomastoid region, is irregularly nodular, hard, usually cystic and fluctuant in parts, and adherent to all the surrounding structures (Fig. 12). Red or violaceous skin color, tenderness, breaking down in localized areas or sinus formation may occur. Pain may be either localized or radiating and there may be dysphagia, hoarseness, cough and loss of weight. In one of our cases that had had a radical operation, the mass was found firmly adherent to surrounding structures, including the internal jugular vein. In previous years, when radical excision of the mass was the treat-

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ment of choice, intimate adhesion to the internal jugular vein was found almost invariably by von Volkman,⁷ Veau¹⁵ and Lorenz.⁵⁵

The prognosis is bad. Three of our cases died of cachexia within a period of two years from the onset of the swelling. There were no observed metastases. The fourth is still alive with a swelling of eighteen months' duration. He has had radiotherapy without improvement. The treatment

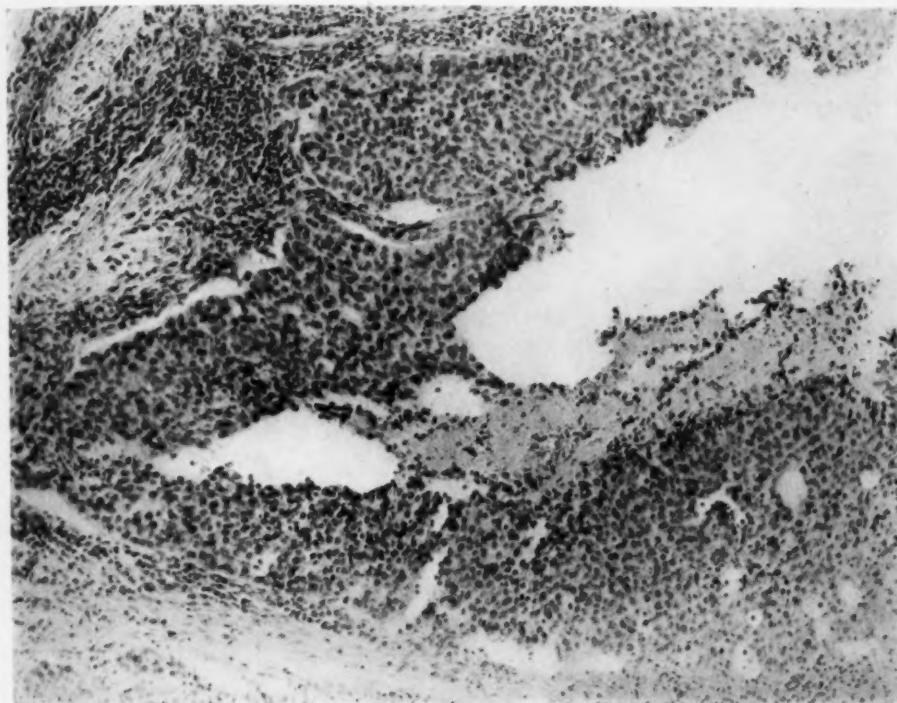


FIG. 13.—Microphotograph of one of the cystic spaces in a branchial epithelioma. It is lined with relatively undifferentiated tumor cells showing many mitoses. The surrounding stroma is densely infiltrated with inflammatory mononuclear cells. (Case history No. 18576).

in the three observed cases varied from radical surgery to X-ray or radium therapy.

A differential diagnosis must be made from tumors of the carotid body, lymph-glands, the antero-inferior portion of the parotid and from an aberrant thyroid.

ANALYSIS OF TWENTY CASES OF BRANCHIAL CYSTS

Age Occurrence

Years	No. Cases	Per cent.
1-5	1	5
6-10	2	10
11-20	5	25
21-30	8	40
31-40	2	10
41-50	2	10

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		Years
	Youngest	1
	Oldest	49
	Average	22
	Every male was over twenty years.	
<i>Sex</i>	No. Cases	Per cent.
	Female	13 65
	Male	7 35
<i>Side</i>		
	Left	12 60
	Right	8 40
<i>Duration Before Operation</i>		
	Shortest	3 weeks
	Longest	4 years
	Average	11 months
	No. Cases	Per cent.
	Cystic or fluctuant	12 60
	Movable	9 45
	Location—anterior and beneath sternomastoid	17 85
<i>Size, when examined (14 cases)</i>		
	Largest	10 x 8 cm.
	Smallest	2 x 3 cm.
	Average	5 x 5 cm.
	No. Cases	Per cent.
<i>Inception with cold or sore throat</i>	2	10
<i>Pain</i>		
	Localized	2 10
	On swallowing	3 15
<i>Continued to drain after incision</i>	3	75
<i>Recurrence</i>	1	25
<i>Redness of skin</i>	1	6
<i>Operative Findings</i>		
	Extended to great vessels	17 85
	Deep to great vessels	1 5
	Superficial to fascia	1 5
	Not stated	1 5
	Prolongations to parotid	1
	Prolongations to base of skull	1
<i>Cyst contents (gross observation)</i>		
	Thick pus	5 25
	Thick amber fluid	1 5
	Gray turbid fluid	2 10
	Thin necrotic material	1 5
	Not stated	11 55
<i>Lymph gland involvement</i>	10	50
<i>Results</i>		
14 cases were followed:		
	Shortest follow-up	2 months
	Longest follow-up	51 months
	Average follow-up	19 months
	No recurrences.	

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Mistaken Diagnoses (in hospital)

Tuberculosis of cervical lymph-glands:

	No. Cases	Per cent.
Pre-operative, alone	11	55
Pre-operative and operative	7	35

SYNOPSIS OF TWENTY BRANCHIAL CYSTS

Hospital No. 43364; age, fifty; sex, male; occupation, fireman. Ante-operative duration, twelve months; side, left. Previous operation, none.

Symptoms and Signs.—Gradual increase in size of swelling 5 x 8 cm. A soft ovoid fluctuant, movable, encapsulated non-tender mass, anterior to and beneath sternomastoid. X-ray showed shadow in soft tissue.

Operative Findings.—A deep purple cyst, 5 cm. in diameter, lay along the anterior margin of the sternomastoid muscle close to the carotid sheath and beneath the angle of the jaw. Excised without rupture. (Dr. John M. Hanford.)

Pathology.—Cyst contained a greenish-purple sticky fluid. There was a great deal of lymphoid tissue in the fibrous wall but no epithelial lining could be demonstrated. There was a lymph-node with the cyst.

Result.—Two months no recurrence but paralysis of depressor labii inferioris. Twenty-seven months no recurrence, paralysis gone.

Hospital No. 55161; age, twenty-six; sex, male; occupation, letter carrier. Ante-operative duration, three-fourths months; side, right. Previous operation, none.

Symptoms and Signs.—Gradual increase in size of swelling. Sometimes size diminishes. Soft, fluctuant swelling 3.5 x 4.5 cm. deep to sternomastoid, movable on deeper structures and under skin.

Operative Findings.—Thick-walled cyst, 5 x 2.5 cm. beneath sternomastoid, lying on internal jugular vein, slightly adherent to surrounding structures by fine connective-tissue strands. Cyst dissected out easily. (Dr. John M. Hanford.)

Pathology.—Wall varied from 1 to 1.5 mm. in thickness and consisted of dense layer of connective tissue, lined with stratified squamous epithelium 3 or 4 cells deep. Within the connective tissue are mounds of lymphoid tissue. Contents thick, pearly and gelatinous.

Result.—Eight months no recurrence.

Hospital No. 62618; age, twenty-one; sex, male; occupation, student. Ante-operative duration, seven months; side, left. Previous operation, none.

Symptoms and Signs.—Gradual increase in size of swelling. One month ago had pain on swallowing for one day. In upper deep cervical region cystic swelling beneath sternomastoid 10 x 8 cm. Freely movable.

Operative Findings.—Well encapsulated fibrous-walled abscess containing 30-40 c.c. odorless creamy yellow pus. Slightly adherent to surrounding structures. (Dr. John M. Hanford.)

Pathology.—Cavity lined with necrotic material and with squamous epithelium. Great deal of lymphoid tissue in thick connective-tissue coat. Many lymph-glands with it showing no evidence of tuberculosis.

Result.—Thirty-six months no recurrence.

Remarks.—Pre-operative and operative diagnoses were cold abscess.

Hospital No. 48394; age, eight; sex, female; occupation school. Ante-operative duration, one month; side, left. Previous operation, none.

Symptoms and Signs.—Gradual increase in size of swelling, situated in upper deep cervical region, 4 x 4 cm.; cystic, movable on deeper structures and under skin.

Operative Findings.—Mass of lymph-glands matted together, loosely adherent to surrounding structures. At one part a small amount of yellow, turbid fluid appeared. Boundaries of mass above, angle of jaw; behind, sternomastoid; in front, hyoid bone and anterior facial vein. Great auricular nerve seen and spared. (Dr. John M. Hanford.)

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Pathology.—Rounded sac 4 x 4 cm. resembling large lymph-gland, filled with thin greenish pus. Inner lining smooth. Wall varied from 3 to 12 mm. in thickness being composed of lymphoid tissue, scar tissue, and squamous epithelial lining.

Result.—Five months no recurrence.

Remarks.—Pre-operative and operative diagnoses were cold abscess.

Hospital No. 35291; age, nine; sex, female; occupation, school. Ante-operative duration, one month; side, left. Previous operation, none.

Symptoms and Signs.—Gradual increase in size of swelling. It was in upper deep cervical region, tense, not attached to skin.

Operative Findings.—Diffuse mass situated beneath sternomastoid which contained 15 c.c. of creamy yellow pus. Excised with a mass of lymph-glands. (Dr. J. C. Vaughn.)

Pathology.—Rounded mass of tissue 2 cm. in diameter, with a cavity with a roughened red lining, surrounded by firm homogeneous tissue. Cavity lined by squamous epithelium. Separated areas of lymphoid tissue in the wall.

Result.—Nine months no recurrence.

Remarks.—Pre-operative and operative diagnoses were cold abscess.

Hospital No. 56966; age, fifty; sex, male; occupation, clerk. Ante-operative duration, eighteen months; side, right. Previous operation, none.

Symptoms and Signs.—Stationary swelling until three months before admission. Since, gradual increase in size. Globular cystic swelling 2 x 3 cm. below angle of mandible, not attached to skin and attached at one point in region of sternomastoid. Transilluminated.

Operative Findings.—Cystic mass excised from beneath level of diaphragm posteriorly. Very few adhesions. (Dr. Mather Cleveland.)

Pathology.—Cyst 5 x 3.5 cm. with a wall from .5 to 1 mm. in thickness. Inner surface smooth and in part covered with papillary projections. Lined with stratified squamous epithelium, beneath which were rounded masses of lymphoid tissue causing the papillary projections. There was a lymph-gland with it.

Result.—Fifty-one months no recurrence.

Hospital No. 56865; age, twenty-eight; sex, female; occupation, housewife. Ante-operative duration, eighteen months; side, right. Previous operation, incised and drained one and a half years ago for cold abscess.

Symptoms and Signs.—Swelling which was incised and drained for three weeks. Then swelling recurred and for three months had been getting larger. In submaxillary region, oval, cystic, fluctuant swelling 6 x 4 x 2 cm.

Operative Findings.—Firm walled cyst beneath platysma between sternomastoid internal jugular vein and deep fascia. Few fibrous adhesions to surrounding structures. Contents amber, thick fluid. (Dr. John M. Hanford.)

Pathology.—Cyst 3.5 cm. in diameter, wall 1 to 3 mm. thick, lined with a white membrane. This was stratified squamous epithelium, on a connective-tissue base in which was a thick layer of lymphoid tissue.

Result.—Eight months no recurrence.

Remarks.—It was originally excised for cold abscess and then the cyst recurred.

Hospital No. 57791; age, thirteen; sex, female; occupation, school. Ante-operative duration, six months; side, left. Previous operation, incised two months by private M.D. A tube was left in until one week before admission.

Symptoms and Signs.—Swelling six months ago which gradually increased in size. Incised two months ago and still draining. In anterior cervical region at about centre was a fluctuant mass 4 cm. in diameter, attached to skin, slightly movable on deeper parts. At lower margin was a sinus discharging thick yellow pus.

Operative Findings.—Sac, encapsulated, anterior to and beneath sternomastoid. Sac and sinus excised. Internal jugular vein and spinal accessory nerve exposed. (Dr. John M. Hanford.)

BRANCHIAL ANOMALIES AND NEOPLASMS

Pathology.—Thick-walled sac 5.5 x 4 x 3.5 cm. containing a small cavity filled with debris. Cavity lined with stratified squamous epithelium with dense layer of connective tissue containing lymphoid tissue.

Result.—Thirty-four months no recurrence.

Remarks.—Originally incised and drained and subsequently diagnosed tuberculosis of lymph-glands. Intensive X-ray therapy until operation.

Hospital No. 60683; age, twenty; sex, female; occupation, stenographer. Ante-operative duration, seven months; side, left. Previous operation, none.

Symptoms and Signs.—Started with severe cold followed by swelling in neck. Decreased in size in hot weather, but for three weeks had increased in size with slight pain. Vague cystic mass 4 x 5 cm. at angle of jaw, not attached to skin and only slightly to deeper structures.

Operative Findings.—Aspiration of cyst gave 20 c.c. of grayish turbid fluid. Cyst lay beneath upper part of sternomastoid. Slightly attached to surrounding structures, especially deep. Excised. (Dr. John M. Hanford.)

Pathology.—Ovoid cyst 5 x 3.5 cm. Walls bluish-red, fibrous, varying from .1 to 1 cm. Inner surface smooth, grayish and shiny. The fibrous tissue wall lined with stratified squamous epithelium. One part of wall had lymphoid tissue another had none.

Result.—Twenty-one months no recurrence.

Remarks.—Pre-operative diagnosis was tuberculosis of lymph-glands with possibility of branchial cyst.

Hospital No. 60655; age, twenty-six; sex, male; occupation, technician. Ante-operative duration three-quarters months; side, right. Previous operation, none.

Symptoms and Signs.—Gradual increase in size of swelling with slight redness of skin and slight difficulty in swallowing. In the superior carotid triangle cystic mass 6 x 5 cm., overlapped anterior border of sternomastoid, attached to deeper structures, not attached to skin. Upper border hidden beneath angle of mandible.

Operative Findings.—Encapsulated mass 5 x 3 x 3 cm. containing necrotic material. Excised with surrounding lymph-glands. (Dr. Allen O. Whipple.)

Pathology.—Lined with squamous epithelium. Wall thick and fibrous with lymphoid tissue massive in some areas, scanty in others.

Remarks.—Pre-operative and operative diagnoses were tuberculosis of lymph-glands.

Hospital No. 68041; age, fourteen; sex, female; occupation, school. Ante-operative duration, two and one-half months; side, left. Previous operation, incised six weeks before by family physician for adenitis.

Symptoms and Signs.—Sore throat followed by swelling in neck. Incised because of redness and softening. Closure of wound demanded reopening. Below angle of jaw was swelling 5 x 3 cm., fluctuant, tender, movable on all structures. In centre was sinus tract discharging pus.

Operative Findings.—Sinus led into region of upper glands beneath sternomastoid. Mass of glands surrounded tract. Glands and tract excised. (Dr. John M. Hanford.)

Pathology.—Mass 5 x 3 x 2.5 cm. had two cavities filled with pus, surrounded by fibrous tissue. Cavity lined by stratified squamous epithelium, beneath which was large amount of lymphoid tissue. There were short epithelial lined diverticula in wall.

Result.—Two months no recurrence.

Remarks.—Pre-operative and operative diagnoses were tuberculosis of lymph-glands.

Hospital No. 68118; age, thirty-five; sex, female; occupation, nurse. Ante-operative duration, twenty-four months; side, left. Previous operation, none.

Symptoms and Signs.—Swelling barely visible until two and one-half months ago; since then gradual increase in size. Hemispherical fluctuant mass 4 x 4 cm. not attached to surrounding structures.

Operative Findings.—Cyst 3 x 5 cm., not very adherent, contained thick, dark, grumous material. It was beneath sternomastoid. (Dr. John M. Hanford.)

Pathology.—It had a smooth glistening lining of stratified squamous epithelium

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beneath which was thick layer of lymphoid tissue. There were enlarged lymph-glands with it.

Result.—Six months no recurrence.

Remarks.—Pre-operative diagnosis was tuberculosis of lymph-glands.

Hospital No. 48172; age, thirty-five; sex, female; occupation, housewife. Ante-operative duration, four months; side, left. Previous operation, none.

Symptoms and Signs.—Mass gradually increased in size. Under left angle of jaw, smooth, soft, fluctuating mass, slightly movable, size 4 cm. in diameter.

Operative Findings.—Under left angle of jaw was mass of enlarged broken down glands. It was attached to submaxillary gland and extended up to ear. Freed from carotid, internal and external jugular veins. (Dr. Clarence A. McWilliams.)

Pathology.—Irregular fibrous mass 3 x 2 x 1 cm. with a collapsed cyst in it lined with squamous epithelium covering fibrous tissue in which were masses of lymph follicles. About it were lymph-glands which showed chronic inflammation.

Remarks.—Pre-operative and operative diagnoses, tuberculosis of lymph-glands.

Hospital No. 21507; age, twenty-three; sex, male; occupation, steam fitter. Ante-operative duration, fifteen months; side, right. Previous operation, none.

Symptoms and Signs.—Mass gradually increased in size until three months ago when it grew rapidly larger. In submaxillary region was soft, fluctuant rounded swelling 4 cm. in diameter.

Operative Findings.—Discrete thin-walled cyst under deep fascia and anterior to sternomastoid, slightly adherent to surrounding structures. It was oval and contained a thin turbid fluid like sebaceous material found in dermoid cyst. (Dr. E. Eliot, Jr.)

Pathology.—Thin-walled sac 5 cm. in diameter .2 cm. in thickness. The inner surface was slightly granular, lined by stratified squamous epithelium. Outside of this was a large amount of lymphoid tissue.

Result.—Seventeen months no recurrence.

Hospital No. 23027; age, sixteen; sex, female; occupation, school. Ante-operative duration, forty-eight months; side, left. Previous operation, none.

Symptoms and Signs.—Swelling size cherry which stood out on twisting neck to right. Gradual increase in size. Mass in anterior triangle of neck 5 x 5 cm., soft, fluctuant, not attached to skin or deeper parts.

Operative Findings.—Discrete mass, under platysma and lying on great vessels, with one prolongation attached to parotid gland. (Dr. Clarence A. McWilliams.)

Pathology.—Mass 4 x 4 cm.; surface covered by fine adhesions. Cavity filled with light, yellow, cheesy material. Lined by squamous epithelium beneath which was a thick layer of lymphoid and connective tissue.

Result.—Twelve months no recurrence.

Hospital No. 23482; age, five; sex, female; occupation, child. Ante-operative duration, forty-eight months; side, left. Previous operation, thirteen weeks ago incision and drainage by family doctor.

Symptoms and Signs.—Swelling gradually increased in size until operation thirteen weeks ago. Since then there had been intermittent discharge of yellow purulent material. Occasionally cyst filled and became painful. Just to left of midline in lower anterior triangle was a tiny dry reddened sinus mouth.

Operative Findings.—Sinus extended downward beneath the skin about 2.5 cm. and upward 1 cm., entering a cyst about size of hazel nut. The inferior portion was closely adherent to sheath of great vessels, where it ended blindly. (Dr. E. Eliot, Jr.)

Pathology.—Cyst and tract lined with squamous epithelium beneath which was thick layer of lymphoid and connective tissue. There were short diverticula in the wall lined with similar epithelium.

Result.—Twenty-four months no recurrence.

Hospital No. 77179D; age, twenty-three; sex, female; occupation, housewife. Ante-operative duration, two months; side, left. Previous operation, none.

BRANCHIAL ANOMALIES AND NEOPLASMS

Symptoms and Signs.—Swelling had gradually increased in size and at times caused difficulty in swallowing. In carotid triangle was firm, rounded, loosely attached mass beneath the sternomastoid anteriorly.

Operative Findings.—Beneath the mesial border of sternomastoid and adherent to it was a moderately firm, yellowish mass adherent also to big vessels. It was cystic and contained thick yellowish material. (Dr. Dudley Morris.)

Pathology.—Sac is 18 mm. in diameter and 2 mm. in thickness lined with finely granular contents. The lining was stratified squamous epithelium beneath which was a thick layer of lymphoid tissue. Outside of this was a dense layer of stratified connective tissue.

Hospital No. 71663D; age, thirteen; sex, female; occupation, school. Ante-operative duration, two months; side, right. Previous operation, none.

Symptoms and Signs.—Swelling had gradually increased in size.

Operative Findings.—Cystic mass in carotid triangle, attached to great vessels and beneath hyoid. Cyst filled with thin, necrotic material. (Dr. Dudley Morris.)

Pathology.—It was lined with stratified squamous epithelium and had lymphoid tissue in wall.

Hospital No. 69424; age, twenty-six; sex, male; occupation, car tracer. Ante-operative duration, three months; side, right. Previous operation, none.

Symptoms and Signs.—Sudden appearance of swelling which had gradually increased. In upper half of neck was 7 x 8 cm. cystic movable swelling, underneath anterior border of sternomastoid. It extended to midline and level of thyroid cartilage and lower border of jaw.

Operative Findings.—Soft encapsulated cyst 6 x 6 cm. filled with creamy yellowish fluid. It lay under the anterior border of the sternomastoid, over the scalene muscles, behind the sheath of the internal jugular; the upper border was on the posterior belly of the digastric. (Dr. John M. Hanford.)

Pathology.—Cyst was 5 x 2.5 x 2.5 cm. lined with smooth, shiny, stratified, squamous epithelium beneath which was a thick layer of lymphoid tissue. One lymph-gland attached to capsule.

Hospital No. 69638; age, twenty-three; sex, female; occupation, housewife. Ante-operative duration, two months; side, right. Previous operation, none.

Symptoms and Signs.—Sudden appearance of swelling size of moth ball which has gradually increased in size. Very recently there has been slight boring pain in swelling. In upper cervical region, underneath sternomastoid, was 6 x 4 cm. faintly cystic, movable mass.

Operative Findings.—Cyst lay under the upper end of sternomastoid, projecting slightly in front and back of it. The upper end was against the transverse process of the atlas. There were a few firm adhesions. The cyst extended down to the junction of the facial vein with the internal jugular vein. The spinal accessory nerve was adherent to the posterior-superior surface of the cyst. (Dr. John M. Hanford.)

Pathology.—A partly collapsed cyst 4 cm. long with walls 4 mm. thick and containing 10 c.c. of thick pallid semipurulent material. A smear of this showed many pus cells, flat epithelial cells and a few cholesterol crystals. It was lined with squamous epithelium and granulation tissue and had a few germinal centres in the thick fibrous wall. Two small lymph-nodes were with it.

Remarks.—Pre-operative and operative diagnoses—tuberculosis of lymph-glands.

SYNOPSIS OF FOUR BRANCHIAL FISTULAS

Hospital No. 34499; age, seven; sex, female; occupation, school. Ante-operative duration, congenital; side, bilateral. Previous operation, none.

Symptoms and Signs.—Since birth bilateral pinhead-sized openings in neck at level of thyroid cartilage; five years ago swelling appeared around the opening on right and this had gradually enlarged. Three years ago mucoid, clear discharge appeared here

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which later became purulent. The left side discharged occasionally. Often tasted foul material. On either side of thyroid cartilage, near midline was a pin-hole opening. On the right it was surrounded by 2 x 6 cm. swelling which on squeezing exuded thick pus.

Operative Findings.—Fistulous tract superficial at first and then ran under sternomastoid. An inserted probe came out above and behind tonsil. Tract completely excised. (Dr. Clarence A. McWilliams.)

Pathology.—The tract was lined with stratified epithelium and surrounded by lymphoid tissue. It passed through striated muscle and had numerous diverticula passing out into the muscle. In the muscle close to the wall at one point was a group of serous glands (similar to the ones found in the capsule of the tonsil). Here near the pharyngeal end of the tract the epithelium was stratified columnar like the pharyngeal epithelium.

Result.—Ten years no recurrence.

Remarks.—Bilateral, right—complete. Patient's father, brother and female cousin on father's side, and paternal grandfather, all have bilateral cervical fistulas. Another brother (Case No. 69973) has branchial appendage and cleft palate.

Hospital No. 65546; age, eleven; sex, female; occupation, school. Ante-operative duration, congenital; side, right. Previous operation, none.

Symptoms and Signs.—Since birth pin-hole opening in the right side of neck; nine years ago it discharged a little pus when she had pneumonia. Opening had persisted with slight discharge and two weeks ago tender, red swelling appeared around opening, discharging thick, greenish pus. Two centimetres above inner end of sternomastoid at its anterior border was a globular cystic 1 x 1 cm. swelling. No deep tract can be felt.

Operative Findings.—A probe passed into opening went to lower margin of mandible. The tract surrounded by thick fibrous tissue, except at inner end, where it was very friable. Most of tract was superficial to deep cervical fascia. Its upper end was close to the cornu of the hyoid. Inner end of tract tore off and it was carbolized. (Dr. John M. Hanford.)

Pathology.—Tract was 4.5 cm. long. The soft lining was plicated, practically occluding it. The wall varied in thickness from .1 to .2 cm. The tract was lined by stratified columnar epithelium with a dense layer of lymphoid tissue about it.

Result.—Sixteen months no recurrence.

Remarks.—External incomplete.

Hospital No. P. P.; age, five; sex, male; occupation, school. Ante-operative duration, congenital; side, right. Previous operation, none.

Symptoms and Signs.—At birth a pinhead-sized pimple noticed on right side of neck. Three years ago swelling opened and discharged small amount of mucoid material. Since then the fistula closed and opened intermittently, the discharge being more profuse when the child had a cold. Occasionally a small swelling formed about the opening. For two years had a dry cough worse at night, and when the sinus was not discharging. At anterior border of right sternomastoid about 3 cm. above sternoclavicular junction was soft, non-tender, fluctuating cystic mass, 3 mm. in diameter, with a pinhead, reddish area in the centre. Cystic mass became a little larger on coughing.

Operative Findings.—The tract went through platysma, sheath of sternomastoid and carotid sheath between the carotid artery, internal jugular vein and vagus nerve. It was in intimate contact with the vagus for a short distance and slightly adherent to it at one point. It then coursed obliquely upward and backward to the pharynx, where it ended blindly. The pharyngeal end was thin and friable. (Dr. Louis Carp.)

Pathology.—The excised tissue 3 cm. long was fibrous and muscular and had a narrow tract containing mucoid material passing through it. The tract was lined with stratified squamous epithelium with a great deal of lymphoid tissue immediately surrounding. It passed through a mass of striated muscle in which were several groups of nerve fibrils.

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Result.—Day of operation cough stopped; twenty-four months no recurrence or cough. Forty-eight months no recurrence or cough.

Remarks.—Incomplete external. Symptoms of vagus nerve irritation.

Hospital No. 69188; age, eight; sex, female; occupation, school. Ante-operative duration, congenital; side, left. Previous operation, none.

Symptoms and Signs.—At birth small opening just to left of midline in lower part of neck. Since tonsillectomy five years ago had discharged "pus". There was a sticking pain locally and on swallowing. There was slight swelling around opening when it closed. There was about one-half teaspoonful discharge a day. Opening just below level of cricoid along anterior margin of sternomastoid. Tract could be felt a few centimetres under skin upward. No opening in pharynx.

Operative Findings.—Fluid in injected sinus came out in pharynx. The tract extended upward beneath tendon of digastric muscle and hypoglossal nerve and then dipped down to pharynx. The tract was dissected out to this point. Stump carbolized and sewn over. (Dr. Frank L. Meloney.)

Pathology.—Elongated mass of purplish tissue 5.5 cm. in length. At one end was an elliptical piece of skin with a 2 mm. opening in the centre. The wall of the tract was white and 1 mm. thick. Tube surrounded by thin layer of fibrous tissue in which were patches of lymphoid tissue and directly outside of this striated muscle. In one part the tube was lined by stratified squamous epithelium and near the pharyngeal end by stratified columnar epithelium.

Remarks.—Complete fistula.

Result.—Seven months—no recurrence.

SYNOPSIS OF FOUR BRANCHIAL APPENDAGES

Hospital No. 69973; age, twenty; sex, male; occupation, farmer. Ante-operative duration, congenital; side, left. Previous operation, none.

Symptoms and Signs.—Presence of mass in lower anterior part of neck 2 cm. above sternoclavicular junction. At anterior border of sternomastoid was a pinhead-sized dimple beneath which was an irregular cartilaginous flexible mass 2 cm. in diameter attached to skin and apparently to the anterior border of the sternomastoid.

Operative Findings.—The mass was adherent to the skin and the sternomastoid. It contained cartilage with a few sharp projections. The cartilage lay between the platysma and the tendon of the sternomastoid muscle. (Dr. William Barclay Parsons, Jr.)

Pathology.—The cartilage was of the elastic type like that of the auricle. It was surrounded by perichondrium and the dimple in the skin was due apparently to close attachment of skin to perichondrium. There was evidence of cartilage proliferation at one point on the periphery.

Remarks.—Operated on for cleft palate in infancy. Has right congenital inguinal hernia. (This patient is brother of Case No. 34499.)

Hospital No. 37556; age, seventeen months; sex, male; occupation, infant. Ante-operative duration, congenital; side, left. Previous operation, none.

Symptoms and Signs.—Mass present since birth, had not increased in size. In left side of neck over centre of sternomastoid at anterior border was a rounded, soft, protruding mass 2 cm. in diameter. A cord-like structure ran from it toward the midline where it became lost.

Operative Findings.—On opening subcutaneous tissue a bar of cartilage 1 cm. long was found which passed backward and outward. It did not connect with a cyst or cleft. (Dr. Allen O. Whipple.)

Pathology.—Nipple-shaped mass 1 x 1.5 cm. covered by normal hairy skin and subcutaneous fat. In the centre was an oval mass of fibrocartilage 1 x 2 mm.

Result.—Two months no recurrence.

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Hospital No. 137795D; age, five; sex, female; occupation, child. Ante-operative duration, congenital; side, left. Previous operation none.

Symptoms and Signs.—Growth had gradually increased in size. In front of ear and attached to tragus is a bilobed, cartilaginous growth, freely movable.

Operative Findings.—Excision. (Dr. John M. Hanford.)

Pathology.—The growth is normal hair-bearing skin and subcutaneous fat 7 mm. long with a bar of fibrocartilage 1 mm. in its centre.

Result.—Twenty-four months no recurrence.

Hospital No. 67433; age, twenty-six; sex, male; occupation, shipping clerk. Ante-operative duration, congenital; side, left. Previous operation, none.

Symptoms and Signs.—Gradual increase in size. Prominent nipple-like projection 1.5 cm. long in left lower anterior triangle of neck. It was stiffened by a firm cartilage-like central bar which extended subcutaneously.

Operative Findings.—Mass covered with skin and subcutaneous tissue and in its centre was a stiff bar of cartilage. It was adherent to platysma. (Dr. C. L. Janssen.)

Pathology.—Gross specimen was lost.

SYNOPSIS OF FOUR BRANCHIAL EPITHELIOMAS

Hospital No. 35740; age, fifty-one; sex, male; occupation, cleaner. Ante-operative duration, two months; side, right. Previous operation, incision and drainage of mass above the present one fifteen years ago. Drained for one year.

Symptoms and Signs.—Swelling increased in size rapidly and at times decreased. Recently pain, redness, tenderness and softness. Mass was ovoid, extended from midline outward 10 cm. and was 7 cm. vertically adherent to all structures, surface coarsely nodular, hard and fluctuant in lower portion.

Operative Findings.—Mass composed of firm but friable tissue separating numerous cystic cavities which contained a small amount of cloudy fluid under slight tension. Exploration and biopsy. (Dr. James A. Corscaden.)

Pathology.—An invasive tumor forming cyst-like spaces with papillary projections lined with squamous epithelial tumor cells and mitoses averaged two to every high power field. Little differentiation and no tendency to pearl formation.

Result.—Four months, died (cachexia).

Hospital No. 18576, 20026, 23080; age, sixty-seven; sex, male; occupation, laborer. Ante-operative duration, six months; side, right. Previous operation, none.

Symptoms and Signs.—Growth increased rapidly in last three months, forming a sinus discharging cheesy material. When sinus closed mass grew larger. A firm fluctuant mass 5 x 5 cm. attached to reddened skin and deeper structures.

Operative Findings.—Mass 5 x 5 cm. firmly adherent to surrounding structures and internal jugular vein. A prolongation ran back to the base of the skull. (Dr. Clarence A. McWilliams.)

Pathology.—A relatively undifferentiated neoplasm composed of strands of cuboidal and squamous cells with a tendency to necrosis, mitoses averaged three to every high power field. It tended to form small cystic spaces with papillary projections into them lined with tumor cells.

Result.—Six months local reappearance, exuberant granulations and foul odor. Excised, seven months post-operative; wound healed and health improved. Nine months reappearance, again excised. X-ray therapy, twenty-four months; died (cachexia).

Hospital No. 23511; age, forty-two; sex, male; occupation, waiter. Ante-operative duration, one month; side, left. Previous operation, none.

Symptoms and Signs.—Growth started as size of plum; had not increased in size. For one week it had been painful and for three days there had been difficulty in swallowing. In front of sternomastoid about in centre was a hard mass 5 x 2 x 3 cm. attached to deeper structures but not to skin.

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Operative Findings.—Mass size of egg firmly adherent to sternomastoid. Hard and infiltrating specimen excised. (Dr. George E. Brewer.)

Pathology.—Relatively undifferentiated squamous cells. There was a tendency to form small cystic spaces with papillary projections into them—lined with tumor cells. Mitoses average one to every high power field. Spaces *not* due apparently to necrosis of cells as there are no necrotic cells in them and the lining has not degenerated.

Result.—Two months lost ten pounds. Mass larger in eight months, losing weight and strength in spite of X-ray therapy. Wound discharging. Nine months, died (cachexia).

Hospital No. 96387; age, sixty; sex, male; occupation milling. Ante-operative duration, twelve months; side, right. Previous operation, none.

Symptoms and Signs.—Swelling size of marble, which had gradually increased in size. Severe pain radiating to scalp and behind ear for four months. Recently voice hoarse, dry cough, loss of weight. Emaciated man in pain. Nose, pharyngeal examination negative. Swelling 9.5 x 4.5 cm. projected 3 cm. over middle of sternomastoid and extended into anterior triangle of neck. Nodular firmly adherent and anteriorly an area of softening.

Operative Findings.—Biopsy—softened area contained thick pus. (Dr. Louis Carp.)

Pathology.—The growth made up of epithelial-cell masses with only slight tendency to differentiation and pearl formation. Some collapsed cysts lined with many layers of squamous tumor cells. Few mitoses.

BIBLIOGRAPHY

- ¹ Hunczowski: *Bibl. der Must. med. chir. Liter. fuer die K. Feld, Chirurgen*, 1789, vol. i, p. 170.
- ² Dzondi, Carolus Henricus: *De fistulis tracheæ congenitis*. Halis Sax., 1820.
- ³ Asherson, Ferdinand Mauritius: *De Fistulis colli congenitalis*. Berlin, 1832. Phœbus Preuss ver. Zeitung, 1834, p. 247.
- ⁴ Heusinger: *Hals-Kiemen Fisteln von noch nicht beobachteter Form*. Arch. f. path. Anat., 1864, vol. xxix, pp. 358-380.
- ⁵ Fisher, Georg: *Historische Notiz zur angeborenen Halsfistel*. Deutsch. Zeit. f. Chir., 1873, vol. ii, pp. 570-571.
- ⁶ Cusset, Jean: *Étude sur l'appareil branchial des vertébrés et quelques affections qui en dérivent chez l'homme (fistules branchiales, kystes dermoïdes, kystes branchiaux)*. Thèse de Paris, 1877.
- ⁷ von Volkmann, Richard: *Ueber die branchiogenen Karcinom*. Beit. z. Klin. Chir., 1890, vol. xxiii, fasc. iii, p. 595.
- ⁸ Senn, Nicholas: *On Branchial Cysts of the Neck*. Jour. A. M. A., 1884, vol. iii, pp. 197-209.
- ⁹ Quénu, E.: *Des arcs branchiaux chez l'homme*. Thèse de Paris, 1886.
- ¹⁰ Richard, H.: *Ueber die Geschwülste der Kiemenspalten*. Bruns. Beit. z. Klin. Chir., 1888, vol. iii, p. 165.
- ¹¹ Hahne, A.: *Ueber Fistula Auris congenita*. Göttingen, 1889.
- ¹² Gussenbauer: *Beitrag zur Kenntnis des branchiogenen Geschwülste*. Fest. Th. Bilroth, 1892, p. 250.
- ¹³ Sultan, G.: *Zur Kenntnis der Halszysten und Fisteln*. Deutsch. Zeit. f. Chir., 1898, vol. xlviii, H. 2-3, pp. 113-155.
- ¹⁴ Perez, *Ueber die branchiogenen Karcinom*. Beit. z. Klin. Chir., 1899, vol. xxiii, fasc. iii, p. 595.
- ¹⁵ Veau, Victor: *L'Epithelioma branchial du Cou*. Thèse de Paris, 1901, No. 204.
- ¹⁶ Whitacre, Horace J.: *Persistent Thyroglossal Duct; Complete Branchial Fistula*. ANNALS OF SURGERY, 1903, vol. xxxvii, pp. 56-64.
- ¹⁷ Siegel, Robert: *L'Epithelioma branchial du Cou*. Thèse de Paris, 1908, nr. 267.
- ¹⁸ Rathke: *Ueber das Dasein von Kiemenandeutungen bei menschlichen Embryonen*. Isis von Oken, 1828.

CARP AND STOUT

- ¹⁹ Bland-Sutton, J.: On Branchial Fistulae, Cysts, Diverticula and Supernumerary Auricles. *J. Anat. and Phys.*, 1887, vol. xxi, pp. 289-298.
- ²⁰ von Kostanecki and von Mielecki, A.: Die angeborenen Kiemenfisteln des Menschen. *Arch. f. path. anat. u. Phys.*, 1890, vol. cxx, pp. 385-436; vol. cxxi, pp. 55-87.
- ²¹ Rabl, Hans: Ueber die Anlage der Ultimobranchialen Koerper bei den Voegeln. *Arch. f. Micro. Anat. u. Entwickl.*, 1907, vol. lxx, pp. 130-169.
- ²² Wenglowski, Romuald: Ueber die Halsfisteln und Cysten. *Arch. f. Klin. Chir.*, 1912-1913, vol. c, pp. 789-892.
- ²³ Frazer, J. Ernest: The Disappearance of the Precervical Sinus. *J. Anat.*, 1926, vol. lxi, pp. 132-143.
- ²⁴ Cuning, Joseph: A Case of Branchial Cyst. *Med. Press and Circular*, 1907, vol. i, p. 228.
- ²⁵ Coakley, C. G.: A Branchial Cleft Cyst Simulating a Chronic Retropharyngeal Abscess. *Trans. Amer. Laryn. Assn.*, 1904, pp. 19-27.
- ²⁶ Fredet, Pierre, and Chevassu, Maurice: Epithelioma Branchial Intra-parotidien. *Bull. et méd. Soc. Anat.*, Paris, 1902, vol. lxxvii, pp. 621-633.
- ²⁷ Carwardine, Thomas: Dermoid Cyst of a Branchial Cleft. *Bristol Medico-Chir. Jour.*, 1896, vol. xiv, pp. 145-149.
- ²⁸ McFarland, James: Surgical Pathology, 1924, p. 123. Blakiston, Philadelphia.
- ²⁹ Virchow, R.: Ein Tiefes auriculares Dermoid des Halses. *Virch. Arch.*, 1866, vol. xxxv, p. 208.
- ³⁰ Bailey, Hamilton: The Clinical Aspects of Branchial Cysts. *Brit. Jour. Surg.*, 1923, vol. x, pp. 565-572.
- ³¹ Johnson, James A.: Branchial Cysts and Fistulae. *Minn. Med.*, 1926, vol. ix, pp. 514-517.
- ³² McKenty, F. E.: Tumors of the Neck. *Surg., Gyn. and Obstet.*, 1914, vol. xix, pp. 141-151.
- ³³ Heusinger, C. F.: Zu den Halskiemenbogenresten. *Virch. Arch.*, 1865, vol. xxxiii, p. 177.
- ³⁴ Tilley, Herbert: Discussion of Paper by Whale, G. H. L.: A Case of Branchial Fistula. *Proc. Roy. Soc. Med., Laryngological Section*, 1912-1913, vol. vi, p. 36.
- ³⁵ Fischer: Ueber die angeborenen Formfehler des Rachens. Halle, 1895.
- ³⁶ Virchow, R.: Ein neuer Fall von Halskiemenfistel. *Arch. path. Anat.*, 1865, vol. xxxii, pp. 518-524.
- ³⁷ Kramer, Rudolph: Lateral Cervical Fistulae. *The Laryngoscope*, 1926, vol. xxxvi, pp. 517-522.
- ³⁸ Carp, Louis: Branchial Fistula—Its Clinical Relation to Irritation of the Vagus. *Surg., Gyn. and Obstet.*, 1926, vol. xlii, pp. 772-777.
- ³⁹ von Hacker: Exstirpation der kompletten seitlichen Halsfistel mittels Exstraction des oberen Strangendes von der Mundhoele aus. *Central. f. Chir.*, 1897, vol. xxiv, pp. 1073-1076.
- ⁴⁰ Gross, W.: Die Operationen der kompletten Halsfistel. *Central. f. Chir.*, 1926, vol. liii, pp. 2076-2080.
- ⁴¹ Meyer, Herbert Willy: Congenital Complete Branchiogenetic Cyst and Duct. *Amer. Jour. Surg.*, 1926, vol. xl, p. 121.
- ⁴² Lilienthal, Howard: Branchial Fistula. *ANNALS OF SURGERY*, 1922, vol. lxxv, pp. 119-120.
- ⁴³ Douglas, John: Branchiogenetic Cyst with Sinus Leading into Pharynx. *ANNALS OF SURGERY*, 1918, vol. lxvii, p. 240.
- ⁴⁴ Siemens, Hermann Werner: Zur Kenntniss der sogenaunten Ohr and Halsanhaenge. *Arch. f. Dermat. und Syphylis*, 1921, vol. cxxxii, pp. 186-205.
- ⁴⁵ Guszman, Joseph: Beitrage zur lehre der branchiogenen Ohr und Halsanhaenge. *Zeit. f. die Ges. Anat.*, 1926, vol. cxxxii, pp. 554-562.

BRANCHIAL ANOMALIES AND NEOPLASMS

- ⁴⁶ Ferran, M. T.: Fibrochondrome branchial et Macrostomie. Bull. de la Soc. Anat. de Paris, 1910, vol. lxxxv, pp. 742-743.
- ⁴⁷ Klausner: Mehrfachbildungen bei Wirbeltieren. Muenchen, 1890.
- ⁴⁸ Clarke, William Cogswell: Verbal Communication.
- ⁴⁹ Hamann, C. A.: Cases of Congenital Auricular and Cervical Fistulæ. Cleveland Med. Gaz., 1893-1894, vol. ix, pp. 110-112.
- ⁵⁰ Stammers, F. A. R.: Pre-auricular Fistulæ. Brit. Jour. Surg., 1926-1927, vol. xiv, p. 359.
- ⁵¹ von Volkman, Richard: Das tiefe branchiogene Halscarcinom. Zentral. f. Chir., 1882, vol. lx, p. 49.
- ⁵² Leboeuf, P. N. A.: Contribution à l'étude des branchiomes épithéliaux de la région cervicale. Bordeaux, 1903.
- ⁵³ Zicas, B.: Contribution à l'étude des épithéliomes branchiaux. Thèse de Paris, 1903.
- ⁵⁴ Brünnet, G.: Ueber des branchiogenen Karzinom. Samml. Klin. Vortr., 1903, nr. 360, pp. 555-566.
- ⁵⁵ Lorenz, H. E.: Das branchiogene Carcinom. Beit. z. Klin. Chir., 1913, vol. lxxxv, pp. 599-632.
- ⁵⁶ Maja, A.: Nouvelle observation d'épithélioma branchial chez le chien. Bull. Soc. centr. med. vet., 1910, vol. lxiv, p. 168.
- ⁵⁷ Petit, G., d'Alfort, Fichet and Larioux: Deuxième cas de cancer branchial chez le cheval. Bull. de la Soc. Anat. de Paris, 1911, vol. lxxxvi, pp. 594-595.
- ⁵⁸ Richardson, Maurice L.: Branchiogenic Carcinoma, with Report of a Case. Cleveland Med. Jour., 1915, vol. xiv, pp. 581-589.
- ⁵⁹ Brandt, G.: Beiträge zur Frage des branchiogenen Karzinoms. Deutsch. Zeit. f. Chir., 1924, vol. clxxxvii-clxxxviii, pp. 15-21.
- ⁶⁰ Hudson, Rupert Vaughan: The So-called Branchiogenetic Carcinoma: Its Occupational Incidence and Origin. Brit. Jour. Surg., 1926, vol. xiv, pp. 280-294.
- ⁶¹ Ewing, James: Neoplastic Diseases, 1922, p. 968. Saunders, Philadelphia.
- ⁶² Johnson, Raymond and Lawrence, T. W. P.: Article "Tumours" in Choyce, C. C., A System of Surgery, 1923, vol. i, p. 560.

CERTAIN EFFECTS OF OBSTRUCTION OF THE BILE DUCTS*

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THE gross and microscopic anatomy of the biliary system has been studied by many investigators since the time of Kiernan in 1833. His thesis on the anatomy and physiology of the liver gave the first comprehensive description of its intimate structure and functional activity. He gave particular attention to the ultimate connection of the bile-ducts with the hepatic cells, and made his observations by means of a hand lens and injection of the biliary system with cinnabar and oil of turpentine.

Grossly he divided the biliary system into the gall-bladder, the common and the cystic ducts, the common hepatic and the right and left hepatic ducts, which divided and subdivided until they united with the hepatic cell columns. The ducts diminished in diameter from the common duct, which averaged approximately 5 mm., to the terminal branches measuring 0.2 mm. in diameter.

He described a few accessory gland-like structures found lying entirely within the walls of the ducts, communicating with the lumen by numerous minute orifices. In the pig, sheep and horse they surrounded the wall completely, anastomosing within it, and opening on the lumen from all sides. In man, however, they were arranged in two rows on opposite sides of the ducts with the orifices preserving the same relationship. Theile, in 1840, by means of similar injections observed that these structures consisted of branching clusters terminating frequently in small caecal diverticula. He considered them mucous glands, comparable to the meibomian glands of the eye.

Beale in 1856³ and again in 1880,⁴ after extensive researches devoted to the subject, confirmed and extended the observations of Kiernan and Theile. Like Kiernan his attention was centred especially on the bile-ducts and on their connections with the hepatic cells. He measured the bile-ducts throughout the descending order of branches and showed that their terminations were directly continuous with the columns of hepatic cells which he stated lay within a cell-containing membrane. The portion of the duct which joined the terminal bile-duct to the cell-containing membrane was 0.003 of an inch in diameter and was the weakest point in the entire biliary system. This portion was devoid of epithelium and was extremely likely to rupture even with the most gentle manipulation.

Beale called the mucous glands of Kiernan and Theile parietal sacculi, considering them epithelial rather than mucous glands. He found that they occurred in the common and hepatic ducts and in all of the intrahepatic branches as far as those measuring $1/125$ of an inch in diameter. He found, also, that while anastomosis between parietal sacculi frequently occurred within the walls of the ducts, quite as often it took place outside them and within the parenchyma of the liver by means of irregular canals springing from the terminal caecal diverticula.

This extraductal network of canals was also noted by Weber, who named them vasa aberrantia. Kölliker described them as existing (1) in the left triangular ligament as six to ten or more canals measuring 0.006 to 0.027 inch in diameter, anastomosing in

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loops and consisting of a basement membrane lined with small cuboidal cells; (2) in the membranous bridge which unites the spigelian and right lobes behind the inferior vena cava, in the membranous band which frequently covers the umbilical vein, and at the edge of the cystic fossa, and (3) in the transverse fissure of the liver. Here they are most prominent and arise from the right and left hepatic ducts as numerous fine branches, distributed through the connective tissue of the capsule of Glisson, covering the fossa and forming a network which unites the two branches within the liver. Weber considered them aberrant biliary ducts, their function being to bring the bile into closer communication with the venous and arterial vaginal plexus for the purpose of concentration. Toldt and Zuckerkandl, on the other hand, believe these structures represent the ductal remains of degenerated hepatic parenchyma.

However, partial sacculi and vasa aberrantia assume importance if considered in the light of the work of Sweet, who recently reviewed the work of Beale and added a further contribution to the subject. If, according to the hypothesis of Beale, these structures were to be considered as small gall-bladders, then they should show some change, either functional or anatomic following cholecystectomy. In animals without the gall-bladder, such as the horse, Sweet found the sacculi to be large and numerous, whereas in animals with gall-bladders, they were flattened and inconspicuous. In dogs after cholecystectomy he noted an immediate rise in blood cholesterol which returned to normal after forty days. Coincident with the fall in blood cholesterol the parietal sacculi enlarged and became hypertrophied. He therefore believed that these structures took over the function of absorbing cholesterol from the bile which Boyd has demonstrated in the normal gall-bladder, in other words, that the parietal sacculi were actually subsidiary gall-bladders.

The bile-ducts ramify in the portal cannals surrounded by Glisson's capsule. Each branch is accompanied by a branch of the hepatic artery and portal vein. According to Mall the intrahepatic branches are divided into at most six orders, the terminal branches arising from the fourth, fifth and sixth.

The biliary tree is of tremendous importance in obstructive lesions, since any obstruction to the common duct will affect the entire system.

The effect of lesions of the gall-bladder and ducts on the liver has been known for many years. However, a determination by actual measurement of the variation in size of the entire biliary tree under such conditions has not been made so far as I can discover.

Frerichs, in 1858, made the first comprehensive study of the subject and his conclusions have in the main been confirmed by subsequent investigators. Wyes and Leyden tied off the common bile-ducts in cats and dogs, and observed the resulting dilatation of the biliary passages with the associated fatty changes in the hepatic cells. Mayer, in 1872, repeating this work, obtained the same results, but also found atrophy of the hepatic cells together with lymphocytic infiltration of the parenchyma. In the same type of experiment, Legg, in 1873, noted among the earliest clinical phenomena, emaciation and jaundice. Dilatation of the ducts extending to the smallest radicles was seen, and a marked increase in the connective tissue surrounding them. From the absence of glycogen in the cells he concluded that the glycogenic function of the liver was soon lost. This work was extended by Harley and Barratt, who ligated the left hepatic bile-duct in a number of cats and found that there was scarcely any gross change in the biliary system within four months. After six months, however, the capsule was wrinkled and the lobules were more prominent on the left than on the right. After twelve months there was marked atrophy of the left lobe and considerable superficial scarring. The bile-ducts were dilated throughout their course, were tortuous, varicose, and filled with

viscid yellowish fluid. Microscopically, atrophy of the hepatic cells was visible with marked deposition of fibrous tissue at the terminal bile-ducts and proliferation of the finest terminal branches. In short, cirrhosis had resulted from chronic obstruction of the ducts. More recently, Rous and Larimore²² have extended these experimental observations.

In regard to the liver of man, Ford and Weber were among the earliest to draw attention to the changes occurring in the bile-ducts and parenchyma from obstruction due to stone, confirming in general the results obtained by experiments on animals.

In this study I wish to show the extent of the injury in various types of obstruction by means of actual measurement of the ducts. The celloidin-injection and corrosion method, which has been used, is one which lends itself particularly well to the purpose. It was often employed by earlier anatomists in the demonstration of the vascular systems of normal structures and occasionally of diseased organs, although not so often as its usefulness warranted. More recently it has been applied to the kidney by Golubew, Brödel, Hinman, Morison and Brown; to the lungs by Marquis, and to the submaxillary glands by Flint and Marshall. The specimen so produced is easily studied, and forms a valuable addition to any pathologic museum, especially if exhibited along with the gross specimens preserved by the usual methods.

The material for study was obtained from subjects at necropsy. For comparison, normal livers were injected and casts made of the biliary trees. A number of livers affected by various lesions of the biliary tract were then obtained and similar preparations made. Four series of preparations have been made: one showing the normal, one the effect of various grades of cholecystitis, one of cholecystectomy and one of benign and malignant strictures of the common duct.

The method has been that used by Hinman, Morison and Brown with certain important modifications. As soon after death as possible the liver is dissected from the abdomen with the diaphragm and as much of the superior and inferior vena cava as possible. The gastrohepatic omentum, containing the portal vein, hepatic artery, and bile-duct, is severed close to the duodenum. Great care is taken not to injure the capsule of the liver at any situation, or leakage will occur. Cannulas with as wide a lumen as possible are then placed in the portal vein and common duct, and a stab hole made in the fundus of the gall-bladder.

The portal vein is connected by rubber tubing to an ordinary cold water faucet and the liver immersed in a tank of cold water. The tap is gradually turned on until there is a free flow from the hepatic veins and the liver is tense almost to the bursting point. I have not found it necessary to use an isotonic solution in washing the organ before injection of either the bile-ducts or blood-vessels, ice cold water being entirely satisfactory. Washing is carried on for varying periods up to twelve hours. It is difficult to remove the bile from the system of blindly ending ducts, but satisfactory casts can be obtained only when this has been successfully accomplished. The high pressure within the capsule is used, first, to squeeze out as much bile as possible, and second, to cause the water to filter through into the ducts and

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wash out the viscid material. Puncturing the gall-bladder prevents overdistention of that organ. When washing is complete the liver is removed from the tank and wrapped in towels; weights up to fifteen pounds are then laid on it. The towels are changed frequently so that in a few hours the accumulated fluid is pressed out and the organ assumes a shrunken appearance and clay-like consistence. This method was first advocated by Beale, and with it I have been able to produce improved specimens.

The cystic duct is next clamped off and the liver connected to the injection apparatus (Fig. 1). This consists of a gas cylinder *A*, connected through

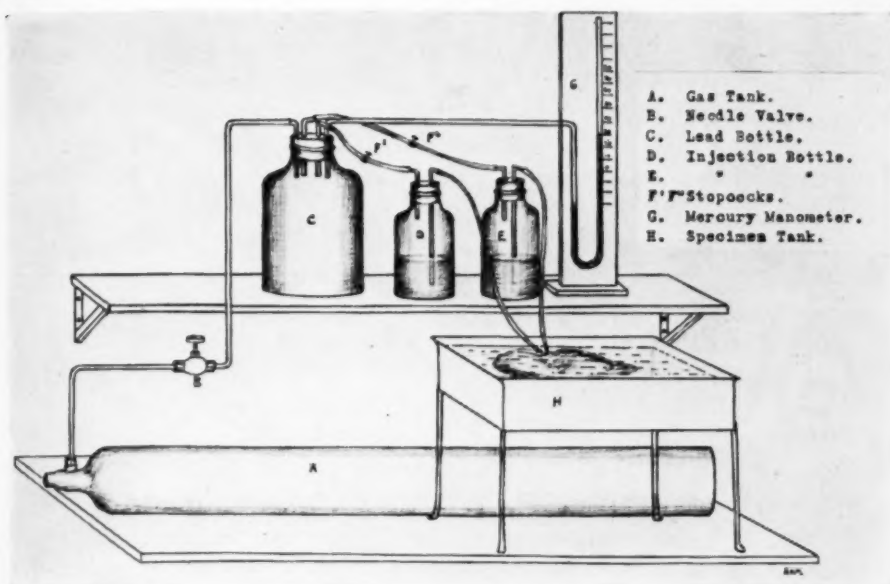


FIG. 1.—Injection apparatus.

a needle valve *B* to a lead bottle *C*. To this any number of injection bottles *D* and *E*, containing injection fluid can be connected, according to the number of vessels to be injected. A manometer *G* records the pressure. The injection fluid consists of a solution of celloidin in acetone prepared according to the method of Hinman, Morison and Brown. Although I keep the stock solutions as recommended by them, I do not use any fixed dilution for injection, but vary it according to the vessel to be injected and the types of injection required. Experience will determine the most suitable consistence. For the bile-ducts I find that a preliminary injection of colloidin of so watery a consistence that it drips easily from a glass rod, followed by one of the consistence of thick cream, gives satisfactory results. I have discarded the dyes commonly used as coloring agents, since I have found artists' oil paints of any standard quality superior, particularly in the smaller branches where an opaque bright permanent color is desirable.

Before the tube from the injection bottle is connected to the cannula, it should be filled with fluid to exclude as much air as possible. All connections

are then made tight and the pressure rapidly raised to 360 mm. of mercury and maintained at that level for six hours. At the end of this time the thick solution is substituted for the thin and injection proceeded with for another period of from twenty-four to thirty-six hours at a pressure of 200 mm. At the same time a slow stream of cold water is run through the portal vein in order to wash out the accumulated acetone and facilitate the hardening of the celloidin in the smaller branches. The long period of injection serves the purpose of filling all the branches completely, so producing a solid cast, and at the same time prevents shrinkage which might take place if hardening occurred after the pressure was released. Sections for microscopic examination can be taken at any time after the medium in the smaller branches is set.

By palpating the common duct one can judge how hardening is progressing; as soon as it is considered complete the liver is removed from the tank and immersed in concentrated hydrochloric acid for from four to five days. The parenchyma is rapidly corroded; any material adhering to the branches of the bile-duct is washed away with a fine stream of cold water. A perfect specimen including the cast of the parietal sacculi and vasa aberrantia should be produced. The specimen should be mounted on a sheet of glass perforated with small holes, through which the branches can be secured with fine thread. It is then sealed in a jar containing a sprinkling of camphor on the bottom covered by a sheet of wet blotting paper, according to the method of Lundquist and Robertson. By this means the celloidin is prevented from drying and becoming brittle.

Results of Study.—In all, twenty-six livers of the four types previously mentioned, were treated in this way. In one instance of malignant stricture of the duct a double injection of the portal vein and bile-duct was made. The calibre of the ducts was measured as accurately as possible with fine external calipers and a screw gauge. Although shrinkage has been eliminated as much as possible by hardening the cast under long-continued pressure, there is no doubt that a certain amount occurred, but it was so slight as to be practically negligible. Since this factor can be taken as constant throughout, the method and conditions being identical for all cases, the measurements afford a good index of the changes in internal diameter of the common hepatic ducts, right and left hepatic ducts, and branches of the first, second, third, fourth and fifth orders.

A thorough study of the casts of ten biliary trees from normal livers was first carried out in order to establish a criterion for the comparison of normal types. (Fig. 2.) The common and hepatic ducts form a comparatively slender trunk varying in diameter from 2.1 to 4.8 mm. Five millimetres was therefore taken as the greatest normal diameter in these passages. Within the hilum of the liver the common hepatic duct divides into right and left branches and these in turn form five or six smaller branches. By a descending order of divisions, diminishing in size but increasing in number, the remainder of the tree is built up until at the fifth order the ducts have become mere filaments. The right hepatic duct varies in diameter from 1.6

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to 3.4 mm., the left from 1.4 to 3.6 mm. Sometimes the left duct is wider than the right, although the reverse is more often true. Branches of the first order vary from 1.1 to 2.2 mm. in diameter, those of the second from 0.8 to 1.5 mm., those of the third from 0.3 to 0.8 mm., those of the fourth from 0.1 to 0.3 mm., and those of the fifth from 0.05 to 0.1 mm. (Table I.)

So far as the ducts themselves are concerned and exclusive of the vasa aberrantia, no anastomosis between the two sides was found as far out as the fifth order of branches, a condition which was also demonstrated in the portal

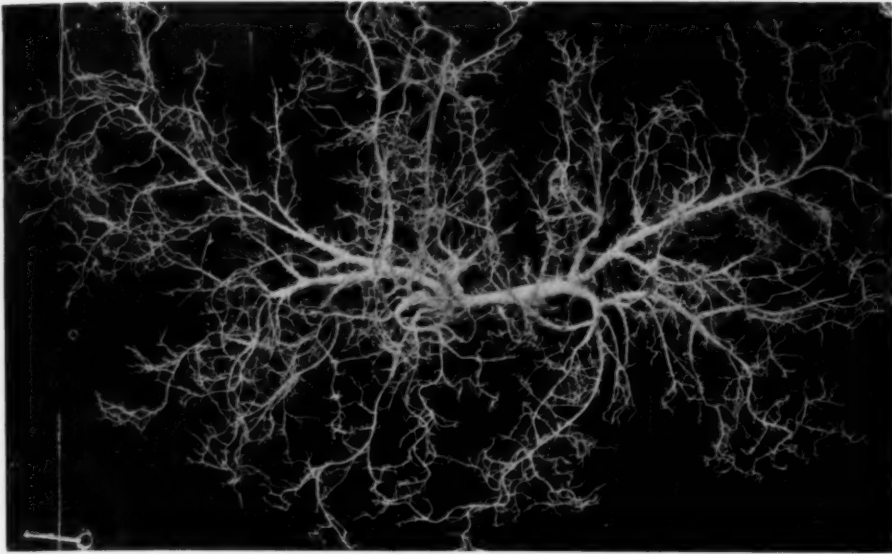


FIG. 2.—Normal biliary tree.

vein. That is to say, outside the bile canalicular and capillary anastomosis there is no gross anastomosis between the right and left branches of bile-ducts or portal vein. In the case of the hepatic artery, an anastomosis of arterioles from side to side is usually established (McIndoe).

As Mall has shown, the finest bile-ducts are given off from the fourth and fifth order of branchings onward. In some of the injections as many as six orders could be counted, although many terminated at the fourth division. It can, therefore, be assumed that the celloidin has penetrated to at least within one branch of the hepatic columns or just proximal to those finer ducts which undergo such marked proliferation in cases of obstructive biliary cirrhosis. The ducts at this point were estimated by Beale to measure from 0.1 to 0.2 mm., which conforms quite accurately to the gross measurements which I have made.

The vasa aberrantia and parietal sacculi are demonstrated by this method and are revealed as a number of anastomosing tubules arising from opposite sides of the ducts and appearing as tortuous, curled, branching processes ending frequently in cap-like dilatations. In the transverse fissure they form a slight anastomosis between the right and left hepatic ducts. The

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parietal sacculi sprout from the opposite sides of the lumen, and within the wall form an anastomosing cluster of small vessels dilated at the distal ends, and frequently connected with the vasa aberrantia. It is rather curious that practically all the branches of the biliary tree and the vasa aberrantia arise from opposite sides of the duct along the lines of the parietal sacculi. In general, therefore, the wall of the duct has two smooth surfaces separated

TABLE I.
Dimensions of Normal Biliary Tree.

Case	Age, sex	Diagnosis	Diameter of ducts, mm.							
			Hepatic			Successive branches in descending order				
			Common	Left	Right	First	Second	Third	Fourth	Fifth
1	25 F	Placenta previa.....	4.0	3.5	3.0	2.1	1.5	0.7	0.1	0.05
2	47 M	Tumor of brain.....	3.0	2.7	2.2	1.5	0.9	0.4	0.2	0.05
3	57 M	Carcinoma of stomach.....	4.0	3.1	4.0	2.0	1.1	0.8	0.2	0.1
4	47 M	Carcinoma of nose.....	4.1	2.8	3.1	2.2	1.4	0.6	0.3	0.08
5	67 F	Tumor of brain.....	3.8	2.4	2.6	1.2	1.0	0.8	0.2	0.1
6	21 F	Dermatomyositis.....	3.9	2.6	2.8	1.4	1.1	0.5	0.3	0.1
7	54 F	Coronary thrombosis.....	3.8	3.0	3.1	2.0	1.2	0.6	0.2	0.07
8	31 F	Pyelonephritis.....	2.1	1.4	1.6	1.1	0.8	0.3	0.1	0.05
9	43 M	Tumor of cord.....	4.8	3.6	3.2	2.0	1.0	0.5	0.2	0.1
10	50 M	Syphilis of central nervous system.....	4.6	3.0	3.4	2.0	1.0	0.5	0.1	0.05

by two rows of afferent ducts. The parietal sacculi can be traced throughout the course of the duct as far out as those measuring 0.1 mm. in diameter.

Cholelithiasis.—Eight specimens were from cases in which the presence of stones in the gall-bladder was revealed only at necropsy. In all cases careful clinical examination had failed to elicit any symptoms which would lead one to suspect that stones had passed down the common duct, so that the effect of stones in the common duct may be excluded. In seven of these cases the ducts had evidently dilated slightly, but throughout the whole system. Thus in this condition the diameter of the common hepatic duct varied from 6.5 to 11.5 mm., of the right hepatic from 3 to 8 mm., of the left

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hepatic from 3.5 to 7 mm., of the first order of branches from 3.5 to 5 mm., of the second from 1.7 to 3 mm., of the third from 0.7 to 1.5 mm., of the fourth from 0.2 to 0.5 mm., and of the fifth from 0.05 to 0.2 mm. (Table II.) Comparing these with the figures obtained from the normal specimens, it will be seen that the increase is fairly uniform throughout, although greatest in the extrahepatic duct. This increase in size gradually diminishes toward the periphery and is not confined to any one set of branches. In Case 2, no dilatation of the ducts occurred and the cast was of an absolutely



FIG. 3.—Biliary tree of a liver in which the gall-bladder was reduced to a fibrous sac. The gradual increase in size of the intrahepatic ducts is shown.

normal biliary tree. Examination of the gall-bladders in this series brought to light some interesting facts. The gall-bladder in Case 2 contained three small stones, but to all appearances was normal, showing no inflammatory thickening, adhesions, or dilatation. The organ must have preserved at least some measure of function. In Cases 12 and 13 the condition was similar, although evidence of chronic cholecystitis was more obvious. In Cases 14, 15, 16, 17 and 18 the gall-bladders were filled with stones and showed extensive thickening and fibrosis of the walls, and in Cases 17 and 18 the gall-bladders were reduced to fibrous sacs and were certainly functionless. Case 17 (Fig. 3) is typical of the group. The specimens in this group show that apparently there is some direct relation between the amount of dilatation of the ducts and the pathologic change in the wall of the gall-bladder.

Cholecystectomy.—Cases in which cholecystectomy has been performed were unsatisfactory, and give few data on the effect of the entire absence of the gall-bladder on the biliary passages. In the three cases in this series death occurred eight, nine and ten days following cholecystectomy which was performed because the gall-bladder was entirely functionless. In none, therefore, can any changes be attributed to extirpation of the gall-bladder at operation. In these cases dilatation of the ducts was similar to that observed

in the previous series, but was most marked in Case 21 (Fig. 4) in which stones were found in the common duct. In Case 19 dilatation was slight and a diameter of only 5.1 mm. was attained in the common hepatic duct. At operation an internal fistula was discovered between the gall-bladder and the

transverse colon which provided for drainage of the biliary system; this serves as an explanation of the absence of dilatation of the biliary ducts.

Strictures (Benign and Malignant).—There were five cases in which the condition was due to stricture of the common duct. (Table III.) In one the lesion was benign and in four it was malignant and caused

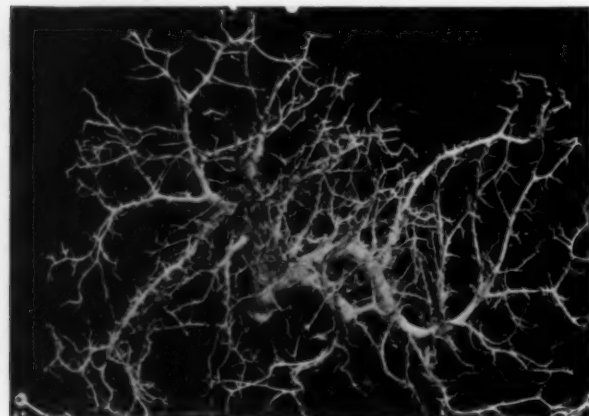


FIG. 4.—Biliary tree in a case of obstruction of the common duct resulting from intermittent attacks of colic.

far greater dilatation. Technical difficulties were encountered in introducing cannulas into ducts, which were frequently found to be a mass of scar tissue at the hilum of the liver, or were disorganized by previous operations; this was especially true in cases of benign lesion. In four cases marked chronic cholangitis had been established, while in one the process was acute and multiple abscesses had formed.

The variation in diameter in the hepatic ducts lay between 10 and 30 mm., the right and left hepatic ducts being from 7.5 to 16 mm., and from 8 to 30 mm., respectively. The extent to which the process had been carried was indicated by the dilatation of the branches; the diameter varied from 4.8 to 13 mm. for the first order, from 3.5 to 8 mm. for

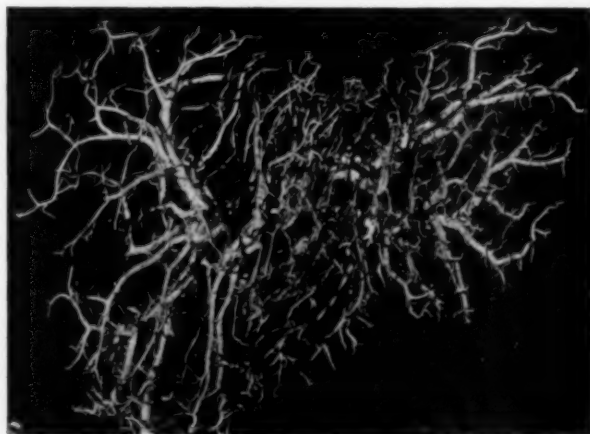


FIG. 5.—Biliary tree in a case of incomplete benign stricture of the common duct following cholecystectomy one year previously. Beginning sacculation.

the second, from 1.4 to 6 mm. for the third, from 0.2 to 1 mm. for the fourth, and from 0.1 to 0.2 mm. for the fifth. The longer and more complete the obstruction, the greater was the dilatation and the further its extent. Between the third and fourth orders of branches, however, a rapid transition

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occurred so that the fifth branching appeared as a terminal filament attached to the stubby dilated duct.

Figure 5 (Case 22) shows the result of a benign fibrous partial stricture following cholecystectomy performed one year before. It may be noted that a much greater degree of dilatation exists here than in specimens of either of the two preceding groups. There is a more abrupt change from the finest terminal ducts to the widely dilated channels of the main trunks, which show beginning sacculatation of their walls. Figures 6 and 7 (Cases 23 and 24, respectively) show the biliary trees in two cases

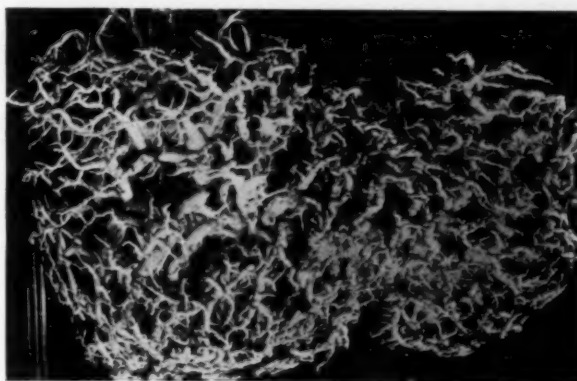


FIG. 6.—Biliary tree in a case of complete obstruction of the common duct of six weeks' duration. The terminal filaments on the tips of dilated and tortuous main trunks are shown.

of complete malignant stricture, the first (Case 23) of six weeks' and the second (Case 24) of eight weeks' duration. In both, sacculatation and varicosity of the ducts is extreme, with well-marked clubbing and stubbiness of the branches of the third and fourth orders giving place to the small terminal

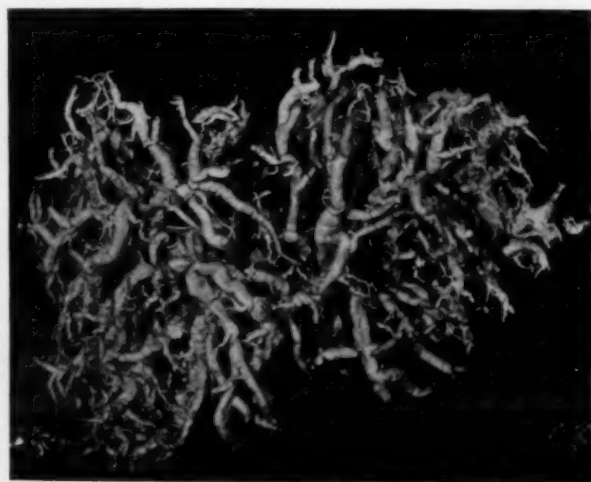


FIG. 7.—Biliary tree in a case of complete obstruction of the common duct of eight weeks' duration; marked clubbing and sacculatation of main bile trunks.

areas supplied. Figures 8 and 9 (Case 26) show superior and inferior views of the biliary tree in a case of malignant stricture of the common duct of ten weeks' duration. Death was caused by acute cholangitis with multiple abscesses, which are represented by the many small nodules attached to the

fifth branches. It is also obvious that as the walls become thin and stretched they become smooth and lose their parietal sacculi. Nearer the hilum of the liver the main trunks lie close together entirely dwarfing the portal vein and indeed, as shown by a simultaneous injection of the ducts and vein in Case 25, causing stenosis and atrophy of many of its smaller branches, with parenchymal atrophy of the

ducts. The condition is comparable only to hydronephrosis, and in its effect on the parenchyma of the liver is entirely similar, to the effect of hydronephrosis on the renal tissue. A comparison between Figure 2 and Figure 9

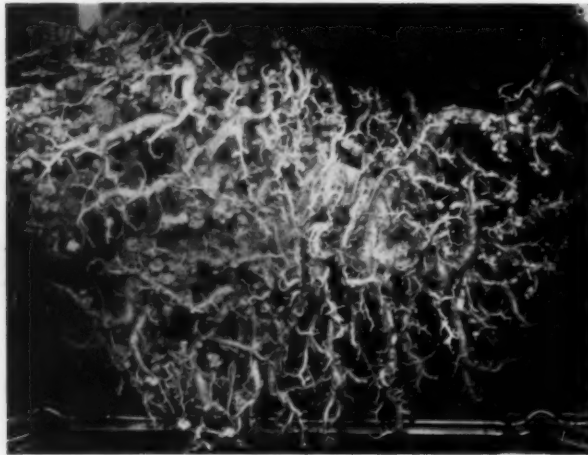


FIG. 8.—Biliary tree (superior view) in a case of complete obstruction of the common duct of ten weeks' duration, with marked suppurative cholangitis. Small abscesses attached to small bile ducts are shown.

is striking, the average diameter of the common hepatic duct in the latter being 30 mm. and of the branches of the third order 6 mm.

The Effect of Obstruction of the Common Duct on the Portal Blood Supply.—Rous and Larimore have recently demonstrated the importance of the portal blood to the maintenance of the liver. They found that occlusion of any local branch of the portal supply produced local atrophy of the parenchyma supplied by the obstructed branch, and compensatory hypertrophy at a distant point. Toldt and Zuckerkandl, in 1876 demonstrated that the normal liver undergoes notable changes in shape from birth to adult life; that some portions of the organ atrophy and others hypertrophy. The atrophy which they observed appeared to be identical with that after portal diversion. They attributed those changes, however, to pressure from surrounding organs. On the other hand, Rous and Larimore believe that the changes result from local alterations in the portal stream, due to transmitted pressure on the surface of the liver.

Portal diversion frequently, if not always, occurs in cases of marked dilatation of the bile-ducts. The left hepatic duct is longer and more slender and comes off at a more acute angle than the right. Normally the bile-duct winds around the portal

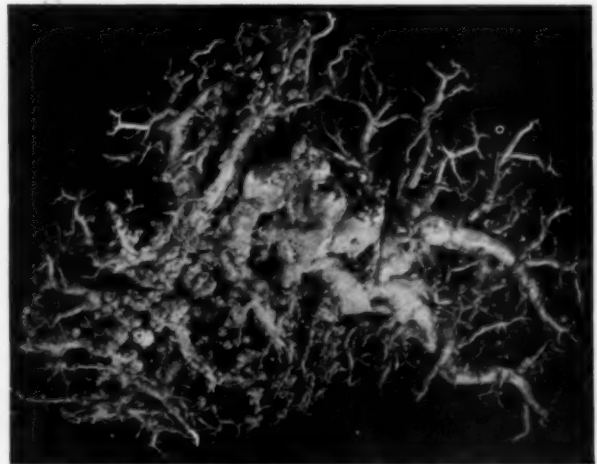


FIG. 9.—Same case as shown in Fig. 8. Inferior view. Note remarkable size attained by the main bile trunks.

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vein. (Fig. 10.) As the bile-ducts dilate, small and sometimes large branches of the portal vein are strangulated, with resulting partial obstruction of the portal vein. In Figure 11, the dilatation of the ducts of the third, fourth, and fifth orders with strangulation of the accompanying portal radicles is depicted. Figure 11 shows marked interference with the main portal blood supply at the hilum by the large dilated and sacculated hepatic bile-ducts. This is in accordance with the well-known pathologic observation of atrophy of the left lobe in obstructive lesions of the common bile-duct and demonstrates the mode of its development.

In most of the cases dilatation was more marked and extended farther in the left lobe than in the right. It is probable that a greater degree of dilatation results from the loss of the protecting hepatic parenchyma. This theory is in accord with the recent experimental work of Hinman and Hepler which showed that a greater degree of hydronephrosis occurred when partial ligation of the renal artery was performed in addition to ligation of the ureter, than when the ureter alone was ligated.



FIG. 10.—Small bile duct winding around the portal vein. Normal relation.

Parietal Sacculi and Vasa Aberrantia.—The parietal sacculi and vasa aberrantia were studied. In

normal biliary trees the parietal sacculi are not particularly prominent features on cursory examination, but on closer examination are seen as small sacculations appearing in two rows, one on either side of the duct. (Fig. 12.) They become smaller in the fourth and fifth orders of branches. The vasa aberrantia, on the other hand, extend beyond the wall of the duct and anastomose frequently. They often project from the parietal sacculi as well as from the wall of the duct itself and appear as curling thread-like structures. They are prominent in the angle between the right and left hepatic ducts but decrease in size along the smaller bile-ducts.

In case disease had destroyed the wall of the gall-bladder, the bile-ducts showed more generalized dilatation. The parietal sacculi and vasa aberrantia were not increased in size or in number. (Fig. 13.) In the case of cholecholelithiasis (Fig. 4) the main bile-ducts were markedly dilated. (Case 21, Table II.) In this case parietal sacculi were entirely absent but appeared along the branches of the fourth and fifth orders. The vasa aberrantia, on the other hand, were somewhat elongated and enlarged and more prominent between the right and left hepatic ducts. They gradually decreased in size until at the fourth order of branches they again appeared normal.

Very little can be said of the results following cholecystectomy, since

TABLE II.
Dimensions of Biliary Trees in Cases of Cholelithiasis and Following Cholecystectomy.

Case	Age, sex	Diagnosis	History of biliary disease	Condition of gall-bladder	Obstruction of common duct	Diameter of ducts, mm.												
						Hepatic			Successive branches in descending order									
						Common	Left	Right	First	Second	Third	Fourth	Fifth					
1	53 F	Fibromyoma; hysterectomy	Indigestion five years	Three stones; partial function		4.0	3.0	3.5	2.0	1.1	0.9	0.5	0.1					
2	51 F	Myocardial degeneration		Multiple stones; functionless (?)		6.5	3.5	3.0	2.4	2.5	1.0	0.4	0.1					
3	69 F	Cerebral hemorrhage		One large stone; partial function (?)		6.7	6.0	4.9	2.8	1.7	0.7	0.2	0.1					
4	54 F	Carcinoma of ovaries		Multiple stones; functionless		7.5	3.8	3.2	2.4	2.7	1.0	0.5	0.2					
5	68 M	Myocardial degeneration		Multiple stones; functionless		8.0	5.1	5.0	3.2	2.1	1.0	0.4	0.05					
6	54 M	Abscess of lung		Multiple stones; functionless		10.0	4.0	5.0	2.5	2.0	1.0	0.4	0.1					
7	65 M	Rectal polypoid; peritonitis		Multiple stones; functionless		10.0	7.0	8.0	5.0	3.0	1.5	0.5	0.1					
8	56 F	Hyperthyroidism		Multiple stones; functionless		11.5	6.0	7.0	4.0	3.0	1.5	0.5	0.1					
9	45 M	Cholecystitis; cholecystectomy	Nausea; vomiting; recurring colic in right upper quadrant for twelve years	Excised nine days before; internal fistula; multiple stones		5.1	3.8	4.0	2.0	1.5	0.7	0.2	0.1					
10	40 F	Cholecystitis; cholecystectomy	Nausea; distress in right upper quadrant for one year	Excised eight days before; multiple stones		7.1	5.3	5.4	3.9	2.1	1.2	0.7	0.1					
11*	62 F	Cholelithiasis; cholecystectomy	Two attacks of jaundice; colic for thirty years	Excised ten days before; contracted and fibrous	Stones	9.0	8.0	7.5	4.8	3.5	1.4	0.2	0.1					

* Stones obstructed common duct.

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in each of the cases examined, cholecystectomy had only recently been performed for cholecystitis and stones. There was no apparent change in the parietal sacculi and vasa aberrantia, so that they resembled those seen in the normal biliary tree and in the system in which the gall-bladder was functionless.

In the case of benign incomplete stricture and in the four cases of complete malignant stricture of the common duct, the entire biliary trees were tremendously dilated. This process was more marked the longer the duration

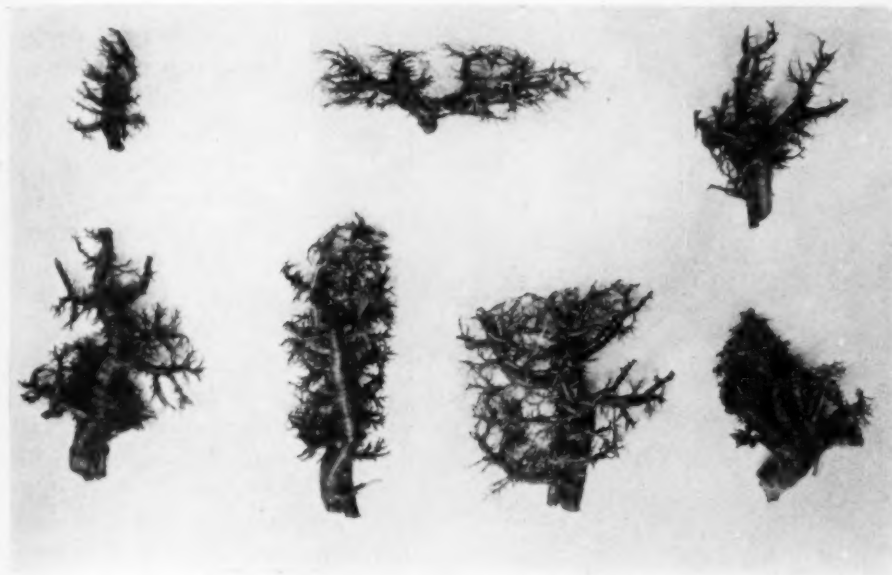


FIG. 11.—Serial view showing strangulation of small portal radicles by dilating bile ducts near the periphery of the liver.

of the obstruction. In all five instances the parietal sacculi had completely disappeared, the wall of the duct appearing smooth. The vasa aberrantia were usually found to be enlarged, curled and somewhat sacculated. In a few instances they were flattened out along the wall of the duct while in others they were so large as to resemble bile-ducts. The abrupt termination of a small branch in a curled, thread-like structure is characteristic of the vasa aberrantia. In the case of malignant stricture of ten weeks' duration their orifices were enormously enlarged and seemed to be in the process of being included by the wall of the dilating duct.

The manner of dilatation of these structures resembles that of the biliary tree, that is the dilatation ceases abruptly near the ends of the ducts, giving one the impression that the factors which produce the enlargement of the biliary tree, also produce the dilatation of the vasa aberrantia and the inclusion of the parietal sacculi.

Discussion.—Until quite recently dilatation of the bile-ducts was considered to be one of the secondary affections of the liver. Nevertheless it is certain that it can assume an importance of the first magnitude. Weber was

perhaps the first to emphasize the relationship between this condition and hydronephrosis and to point out the similarity in the associated lesions. In both conditions, and indeed in conditions of obstruction of the ducts of all secreting glands, secretory stasis, dilatation of ducts, vascular disturbances

from collateral pressure, sclerosis and parenchymatous atrophy are common. The process is more marked in the case of the kidney because the secretory pressure is so much higher. Moreover the slighter degrees of hydronephrosis are more apparent not only on account of the extraparenchymatous situation of the pelvis but by reason of the greater ratio of duct to secreting tissue. Nevertheless, despite the fact that dilatation of the bile-ducts rarely becomes obvious from the exterior, unless it be in the extrahepatic ducts or around the edge of the left lobe, the upset in internal economy is often no less profound.

A brief review of the various grades and types of dilatation of the bile-ducts is desirable. In the group of cases of cholelithiasis, dilatation was mild in seven cases and absent in one. Little except this slight



FIG. 12.—Branch of a normal biliary tree. The parietal sacculi appear as two lateral rows slightly raised from the surface of the duct. The vasa aberrantia are seen as twisted thread-like structures.

generalized increase in diameter served to distinguish the ducts from the normal, although the change was if anything rather more marked in the extrahepatic ducts. The diminution in diameter was gradual and not confined to any one order of branching. In Case 10, no dilatation occurred and the gall-bladder was apparently in good condition even though it contained three

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TABLE III.
Dimensions of Biliary Trees in Cases of Partial and Complete Stricture of the Common Duct.

Case	Age, sex	Diagnosis	History of biliary disease	Condition of gall-bladder	Obstruction of common duct	Diameter of ducts, mm.								
						Hepatic			Successive branches in descending order					
						Common	Left	Right	First	Second	Third	Fourth	Fifth	
1	46 F	Benign stricture of common duct	Cholecystectomy one year previously; jaundice six months	Excised one year before; multiple stones	Partial	10.0	7.5	8.0	5.5	3.7	1.6	0.75	0.1	
2	68 F	Carcinoma of bile ducts	Intermittent jaundice six months; attacks of colic in right upper quadrant	Excised six days before; choledochostomy; multiple stones	Complete for six weeks	14.0	10.5	11.0	7.5	6.0	4.0	1.0	0.1	
3	76 M	Carcinoma of pancreas	Painless jaundice for eight weeks	Distended	Complete for eight weeks	18.0	12.0	13.0	10.0	6.0	3.0	0.5	0.1	
4	71 M	Carcinoma of pancreas	Painless jaundice for seven weeks	Distended	Complete for seven weeks	22.5	13.5	13.0	11.0	10.5	5.6	1.6	0.2	
5	55 F	Carcinoma of pancreas	Increasing jaundice for ten weeks; attacks of colic in right upper quadrant	Distended	Complete for ten weeks	30.0	20.0	16.0	13.0	8.0	6.0	1.0	0.1	

small stones. The amount of dilatation of the ducts in the other seven cases was directly proportional to the amount of injury to the wall of the gall-bladder, being greatest when that organ had been reduced to a fibrous sac. This is in accord with the views of Judd, who finds clinically, that in every case of cholelithiasis in which the gall-bladder is extensively diseased, there is a noticeable dilatation of the extrahepatic ducts. In the cases in which



FIG. 13.—Vasa aberrantia appearing as an anastomosing network between the right and left hepatic ducts and along the walls of the smaller ducts. The parietal sacculi are represented by the rows of knob-like elevations along the sides of the ducts.

cholecystectomy had been performed, dilatation of the bile-ducts also occurred but was least marked when a fistula had been established between the gall-bladder and the transverse colon. It seems that in this case the drainage either prevented dilatation or caused a return of dilated ducts to normal size by relieving intraductal pressure.

In contradistinction to this mild form of dilatation, the gradual partial, or complete occlusion of the ducts from stricture produces a most remarkable picture. There is a tremendous increase in the diameter of the ducts with stretching and thinning of the walls and

consequent obliteration of the pits which form a prominent feature of the normal duct. The process extends more or less uniformly through consecutive branches as far as the fourth and fifth orders. Here there is an abrupt transition from dilated to narrow ducts, the actual site of the change depending on the duration and degree of obstruction. The greater the obstruction the farther out does this transition take place, and the more marked the appearance of stubbiness and clubbing of the smaller branches.

The sphincter of Oddi is the mechanism controlling the flow of bile into the duodenum. The normal intraductal pressure has been variously estimated as from 60 to 70 mm. of bile and the normal tonus of the sphincter as from 60 to 300 mm. Judd and Mann have shown that normally following chole-

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cystectomy the extrahepatic ducts dilate, but that dilatation is prevented by section of the sphincter of Oddi. Rost finds that dilatation fails when the tonus of the sphincter is low. Bollman, Mann and Depage have shown that cholecystitis, produced experimentally by a specific organism, abolishes the concentrating activity of the gall-bladder, while Potter and Mann have demonstrated that cholecystectomy following such an infection causes a marked rise in pressure in the common duct.

It seems, therefore, that the loss of "safety valve" action of the gall-bladder, either by disease or removal of the organ produces generalized dilatation of the ducts, due to the rise in intraductal pressure against the tonic sphincter. These observations confirm and extend the previous experiments of Judd and Mann, and also tend to show that the amount of dilatation is directly proportional to the degree of pathologic change in the wall of the gall-bladder.

The question of portal diversion is interesting and has been the subject of considerable experimental investigation. Rous and Larimore, as previously stated, have definitely shown that when one branch of the portal vein is ligated there follows compensatory hypertrophy of hepatic parenchyma which is supplied by the unobstructed portion of the vein; also that atrophy of hepatic parenchyma occurs in the areas supplied by the obstructed branch of the portal vein. That this condition actually occurs during the process of disease of the biliary tract is certain. (Figs. 10, 11 and 12.) It is explained by the fact that the portal vein normally winds around the bile duct (Fig. 10) and obstruction occurs when the bile-duct dilates to any appreciable extent. Atrophy follows and permits greater dilatation of the bile-ducts, because the supporting parenchyma has been destroyed. By virtue of the position and course of the left branch of the portal vein and left hepatic bile-duct, portal diversion and parenchymal atrophy usually occur earliest here with consequent greater dilatation of the bile-ducts.

An analogy between this condition and hydronephrosis has been drawn by Hinman and Hepler. The greater degree of hydronephrosis which follows partial ligation of the renal artery, together with ligation of the ureter, can be explained on the same basis.

From this investigation it would seem that the parietal sacculi and vasa aberrantia are functionless structures. They are both present under normal conditions. The parietal sacculi disappear from the walls of dilating ducts, while the vasa aberrantia become enlarged and sacculated, and appear as curling, anastomosing structures on opposite sides of the ducts. The extent to which the parietal sacculi disappear and the amount of dilatation of the vasa aberrantia seem to be directly dependent on the intraductal pressure. This theory is further substantiated by the fact that the parietal sacculi, which are located within the wall of the duct, disappear while the vasa aberrantia, which project beyond the duct, become enlarged. It would seem therefore that these structures are altered in shape and size as a result of the increase in intraductal pressure rather than from any functional hyper-

trophy. They can not then be considered as little gall-bladders attached to the walls of the ducts but simply as vestigial remnants of previously functioning structures.

SUMMARY AND CONCLUSION

The biliary trees of twenty-six livers were examined by the celloidin-injection and corrosion method. In ten normal livers, the internal diameter of the common hepatic ducts did not exceed 5 mm., and the diameter of the succeeding branches diminished to 0.05 mm. in the fifth order. Of eight livers in which the gall-bladders contained unsuspected stones, general enlargement of the ducts was found in seven, the diameter of the dilated common hepatic ducts being between 6.5 and 11.5 mm. The dilatation was slightly greater when the injury to the gall-bladder was more severe. In the case in which there was no dilatation the gall-bladder contained three small stones but was otherwise apparently normal. In three cases in which cholecystectomy had been performed, eight, nine, and ten days previous to death, dilatation of the biliary ducts occurred, but was least in a case in which there was an internal fistula between the gall-bladder and colon. In five cases in which benign or malignant strictures of the common duct existed, the amount of dilatation was great and the diameter of the common hepatic duct varying from 10 to 30 mm. The process extended throughout the whole biliary tree, grossly as far as the fifth order of branches. The more complete the obstruction and the longer its duration, the farther the extreme change occurred and the more abrupt was the transition from dilated branches to terminal filaments.

Portal diversion occurred following marked dilatation of the bile-ducts and was associated with atrophy of the hepatic parenchyma in the areas supplied by the obstructed portal branches. This process was accompanied by compensatory hypertrophy in other regions. Dilatation of the bile-ducts was greater in the regions of marked parenchymal atrophy since the supporting tissue tended to prevent over-distention of the ducts.

The parietal sacculi and vasa aberrantia were studied in this series of cases. In normal biliary trees the parietal sacculi were seen as small sacculations appearing in two rows on opposite sides of the ducts decreasing in size as the ducts diminished in calibre. They were not found to be increased in size or number in cases in which the gall-bladder was diseased or had been removed. In cases of choledocholithiasis and benign malignant stricture they were absent.

The vasa aberrantia were seen extending beyond the wall of the duct and anastomosing with each other frequently. They often projected from the parietal sacculi as well as from the wall of the duct itself, appearing as curling thread-like structures. They were more prominent between the right and left hepatic ducts, but were present along all ducts. These structures, like the parietal sacculi, were unchanged in size and number following extensive disease of the gall-bladder and cholecystectomy. In cases of chole-

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docholithiasis and benign and malignant strictures they were tremendously enlarged and sacculated, corresponding in degree to the amount of dilatation of the duct.

The parietal sacculi appeared to be absorbed by the wall of the dilating duct while the vasa aberrantia were enlarged as a result of the increase in the intraductal pressure, proportionate to the amount of dilatation of the ducts themselves.

BIBLIOGRAPHY

- ¹ Archibald, Edward: Ideas Concerning the Causation of Some Cases of Pancreatitis. *Can. Jour. Med. and Surg.*, 1913, vol. xxxiii, pp. 263-268.
- ² Beale, L. S.: On Some Points in the Anatomy of the Liver of Man and Vertebrate Animals with Directions for Injecting the Hepatic Ducts and Making Preparations. London, Churchill, 1856, 80 pp.
- ³ Beale, L. S.: Lectures on the Principles of Medicine. London, Churchill, 1889, 219 pp.
- ⁴ Bollman, J. L., Mann, F. C., and Depage, Pierre: The Effect of Specific Cholecystitis on the Bile-concentrating Activity of the Gall-bladder. *Jour. Lab. and Clin. Med.*, 1925, vol. x, pp. 544-547.
- ⁵ Boyd, W.: Studies in Gall-bladder Pathology. *Brit. Jour. Surg.*, 1923, vol. x, pp. 337-356.
- ⁶ Brödel, Max: The Intrinsic Blood-vessels of the Kidney and Their Significance in Nephrotomy. *Bull. Johns Hopkins Hosp.*, 1901, vol. xii, pp. 10-13.
- ⁷ Cole, W. H.: Relation of Gastric Contents to the Physiology of the Common Duct Sphincter. *Am. Jour. Physiol.*, 1925, vol. lxxii, pp. 39-42.
- ⁸ Flint, J. M.: The Ducts of the Human Submaxillary Gland. *Am. Jour. Anat.*, 1902, vol. i, pp. 269-295.
- ⁹ Ford, W. W.: Obstructive Biliary Cirrhosis. *Am. Jour. Med. Sc.*, 1901, vol. cxxi, pp. 60-85.
- ¹⁰ Frerichs, F. T.: A Clinical Treatise on Diseases of the Liver. London, The New Sydenham Society, 1860.
- ¹¹ Golubew, W. Z.: Ueber die Blutgefäße in des Niere der Säugetiere und des Menschen. *Internat. Monatschr. f. Anat. u. Phys.*, 1893, vol. x, pp. 541-598.
- ¹² Harley, V., and Barratt, W.: The Experimental Production of Hepatic Cirrhosis. *Jour. Path. and Bacteriol.*, 1901, vol. vii, pp. 203-213.
- ¹³ Herring, P. T., and Simpson, S.: The Pressure of Bile Secretion and the Mechanism of Bile Absorption in Obstruction of the Bile-duct. *Proc. Roy. Soc. Med.*, 1907, S. B., vol. lxxix, pp. 517-532.
- ¹⁴ Hinman, Frank, and Hepler, A. B.: Experimental Hydronephrosis. The Effect of Changes in Blood-pressure and in Blood Flow on its Rate of Development and the Significance of the Venous Collateral System. Partial Obstruction of the Renal Vein With and Without Ligation of All Collateral Veins. *Arch. Surg.*, 1925, vol. xi, pp. 917-932.
- ¹⁵ Hinman, Frank, Morison, D. M., and Brown, R. K.: Methods of Demonstrating the Circulation in General as Applied to a Study of Renal Circulation in Particular. *Jour. Am. Med. Assn.*, 1923, vol. lxxxi, pp. 177-184.
- ¹⁶ Judd, E. S.: Personal Communication.
- ¹⁷ Judd, E. S., and Mann, F. C.: The Effect of Removal of the Gall-bladder, an Experimental Study. *Surg., Gynec. and Obst.*, 1917, vol. xxiv, pp. 437-442.
- ¹⁸ Kiernan, F.: The Anatomy and Physiology of the Liver. *Phil. Tr. Roy. Soc., London*, 1883, vol. cxxxiii, pp. 711-770.
- ¹⁹ Kölliker, A.: A Manual of Human Histology. London, The Sydenham Society, 1854, vol. ii, pp. 123-124.

- ²⁰ Legg, J. W.: On the Changes in the Liver Which Follow Ligature of the Bile-ducts. *St. Barth. Hosp. Rep.*, 1873, vol. ix, pp. 161-181.
- ²¹ Leyden, E.: Beiträge zur Pathologie des Icterus. Berlin, A. Hirschwald, 1866, 210 pp.
- ²² Lundquist, L. R., and Robertson, H. E.: Technic of Mounting Specimens in a Partial Vacuum Without Fluid. *Bull. Internat. Assn. Med. Mus.*, 1926, (In Press).
- ²³ Mall, F. P.: A Study of the Structural Unit of the Liver. *Am. Jour. Anat.*, 1906, vol. v, pp. 227-308.
- ²⁴ Mann, F. C.: A Study of the Tonicity of the Sphincter at the Duodenal End of the Common Bile-duct. *Jour. Lab. and Clin. Med.*, 1919, vol. v, pp. 107-110.
- ²⁵ Marquis, W. J.: Celluloid Corrosion Preparation of Lungs. *Bull. Internat. Assn. Med. Mus.* (In Press).
- ²⁶ Marshall, J. A.: A Method for Preparing Blue Celluloid Injection Material. *Jour. Am. Med. Assn.*, 1923, vol. lxxx, p. 181.
- ²⁷ Mayer, H.: Quoted by Legg.
- ²⁸ McIndoe, A. H.: Unpublished Thesis.
- ²⁹ McMaster, P. D., Brown, G. O., and Rous, P.: Studies on the Total Bile. III. On the Bile Changes Caused by a Pressure Obstacle to Secretion and on Hydrohepatosis. *Jour. Exper. Med.*, 1923, vol. xxxvii, pp. 685-698.
- ³⁰ Potter, J. C., and Mann, F. C.: Pressure Changes in the Biliary Tract. *Am. Jour. Med. Sc.*, 1926, vol. clxxi, pp. 202-217.
- ³¹ Rost, F.: Die funktionelle Bedeutung des Gallenblase: Experimentelle und anatomische Untersuchungen nach Cholecystektomie. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1913, vol. xxvi, pp. 710-770.
- ³² Rous, P., and Larimore, L. D.: The Biliary Factor in Liver Lesions. *Jour. Exper. Med.*, 1920, vol. xxxii, pp. 249-272.
- ³³ Rous, P., and Larimore, L. D.: The Relation of the Portal Blood to Liver Maintenance. Demonstration of Liver Atrophy Conditional on Compensation. *Jour. Exper. Med.*, 1920, vol. xxxi, pp. 609-632.
- ³⁴ Sweet, J. E.: The Gall-bladder: Its Past, Present and Future. *Internat. Clin.*, 1924, vol. i, S. 34, pp. 187-226.
- ³⁵ Theile: Quoted by Beale.
- ³⁶ Toldt, C., and Zuckerkandl, E.: Ueber die Form- und Texturveränderungen der menschlichen Leber während des Wachstums. *Sitzungeb. d. k. Akad. d. Wissensch. Math.-naturw. Cl.*, 1875, vol. lxxii, pp. 241-295.
- ³⁷ Weber, E. H.: Ueber den Bau der Leber des Menschen und einiger Thiere. *Arch. f. Anat. Physiol. u. wissenschaft. Med.*, 1843, p. 318.
- ³⁸ Weber, F. P.: On Biliary Cirrhosis With and Without Cholelithiasis. *Tr. Path. Soc. London*, 1903, vol. liv, pp. 103-135.
- ³⁹ Winkelstein, A., and Achsner, P. W.: The Mechanism of the Flow of Bile from the Liver into the Intestines. Conclusions from Previous Studies. *Am. Jour. Med. Sc.*, 1926, vol. clxxi, pp. 104-111.
- ⁴⁰ Wyss, O.: Beitrag zur Histologie der icterischen Leber. *Virchow's Arch. f. path. Anat.*, 1866, vol. xxxv, pp. 553-560.

GASTROJEJUNAL ULCERS AND GASTROJEJUNOCOLIC FISTULÆ

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FROM THE SURGICAL AND GASTRO-ENTEROLOGICAL DEPARTMENTS OF THE LAHEY CLINIC

SINCE Braun reported the first case of gastrojejunal ulcer in 1899, there have been a constantly increasing number of such reports, until to-day the total approaches 1000. The increase is apparently in direct proportion to the growing popularity of gastro-enterostomy as a surgical procedure in cases of gastric and duodenal ulcers.

The last five years are marked by controversial discussion, notably with respect to the relative merits of gastro-enterostomy and partial gastrectomy, and the gastrojejunal ulcer is used as the *pièce de combat*,—those favoring gastro-enterostomy holding that its incidence is so slight as to be quite outweighed by the advantages in the larger percentage of cases; and those who advocate partial gastrectomy arguing that the incidence of gastrojejunal ulcer is actually much greater than is conceded by the exponents of gastro-enterostomy, and that, in any event, it is so unfortunate a lesion and so difficult of treatment (with high tendency to recurrence) that any procedure which may cause it should be avoided.

It has therefore interested us to review its incidence, its causes, and, if possible, means of avoiding such an unfortunate sequela.

Paterson, who wrote an exhaustive article on the subject in 1909, estimated "the probable risk of jejunal ulcer following gastrojejunostomy as under 2 per cent." He collected 52 certain and 10 doubtful cases (including 3 of his own) on record up to 1909, and gives abstracts of the same. Although certain authors of wide experience still report an incidence under 2 per cent., the average incidence as reported in American literature (excluding Lewisohn) is higher—2 to 5 per cent., and in German literature, 5 to 10 per cent. (see Table I).* Lewisohn estimates that the actual incidence is 34 per cent., but this figure has been disputed by many eminent surgeons. Only 3 cases had been reported from America prior to 1909, and Paterson found that leading surgeons at that time, such as John B. Murphy and the Mayo brothers, had not met with a single case, although they were performing about 75 gastrojejunostomies annually. This is, of course, no longer true. Mayo-Robson reported the first case in English literature, in 1904.

Because the incidence is in so many instances published in percentages, often without indication of the total number of cases in the series, to estimate the actual number of reported cases to date seems to us impossible. It should

* It is not claimed that this table is exhaustive, merely representative.

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further be remembered that many cases never find their way into the literature. It is interesting, however, that Ssokolov, a Russian surgeon, states in 1925 that the 126 cases which he worked up from the Russian literature constitute one-seventh of those reported in the world up to that date. This would make the total incidence 882, which we believe might very fairly be raised to 1000.

TABLE I

Incidence of Gastrojejunal Ulcer Following Gastro-enterostomy (All Types)

Author	Incidence
Paterson	3 cases in 348 (also 59 collected cases)
Gosset	79 cases
Deaver	2 per cent.
Mayo, C. H., and Rankin	1 to 3 per cent.
Balfour (1925)	About 2 per cent.
Balfour (1926)	139 cases in 8600. 1.37 per cent. following duodenal ulcer; 0.07 per cent. following gastric ulcer; has seen total of 270 ulcers, 131 gastro-enterostomies performed elsewhere
Judd, E. S.	1.04 per cent. in series of 3324
Moynihan (1920)	4 in 694
Horsley	4 per cent.
Roeder	Not over 5 per cent.
Strauss, A. A. (1925)	20 to 30 per cent.
Lewisohn	34 per cent. (23 in 68 cases); 18 per cent. proved by operation; 16 per cent. diagnosed clinically by X-ray
Pauchet	5 per cent. following gastro-enterostomy alone
Henry	1 case
Ashcroft, A. T.	2 cases
Brickner and Milch	0 per cent. (give careful attention to technic of gastro-enterostomy and to post-operative diet)
Neuhof	1 case
Takats (Budapest)	21 in 626 operations (charity clinic; unable to regulate post-operative diet)
Walton	1.4 per cent. (in 783 cases); 1.7 per cent. after simple gastro-enterostomy
Chiari	11 cases
Pfeiffer and Smith	1 case
Rowlands	1.5 per cent.
MacGuire	2 cases
Barber	1 case
Moschcowitz	"Rare", although he performs many gastro-enterostomies
Erdmann and Carter	"Variously reported from different surgeons as 2 to 10 per cent."
Peck	2 to 5 per cent.
Woolsey	Less than 2 per cent.
Koennecke and Jungermann (Goettinger Clinic)	4 per cent. in series of 520
Renton	3 cases
Finsterer	29 cases (following von Haberer operation)

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TABLE I—Continued

Author	Incidence
Szemoe	1 case
Denk	1 case
Jenckel and Schueppel	7 cases
Mikulicz	2 in 160 cases
Schostak	1 in 92 cases
Rotgaus	1 in 49 cases
Wickenhauser	3 in 115 cases
Moore and Marquis (Mayo Clinic)	2.3 per cent. in 200 cases
Sokolov, S. (review of Russian surgery)	126 cases (reports "world incidence" to 1925 as 1 to 1.5 per cent.)
Sherren	29 cases in 903; 2 cases in 276 (operated on more than two years ago)
Lahey Clinic	16 cases in 340 cases of peptic ulcer

Age and Sex.—Gastrojejunal ulcer occurs much more frequently following duodenal ulcers than gastric, and is comparatively rare in women. Paterson placed the sex incidence at 78 per cent. male. In Balfour's series of 270 cases, only 22 were women; 19 of Walton's 20 cases were men. Fourteen of our 16 cases were in men.

The average age is between thirty and forty, though one case has been observed in a child of two months, operated on for pyloric stenosis, and another in a man over sixty years of age. Michaelson, of Stockholm, reports two cases after gastro-enterostomy in girls aged fourteen and eighteen.

Pathology.—Gastrojejunal ulcers are usually single, although they may be multiple; and are usually smaller than the ordinary peptic ulcer. They are usually situated on the suture line, or on the anterior surface of the jejunum close to the anastomosis, often directly opposite the opening into the stomach. They may, however, be intragastric (Erdmann and Carter), $\frac{1}{4}$ to $\frac{3}{4}$ inch from the anastomotic area. Either the efferent or afferent loops may be the site, but more commonly the efferent.

Walton calls attention to the fact that even when the ulcer is at some distance from the anastomosis, there is always evidence that it started directly at the junction—a scar extending to the anastomotic line.

The ulceration may be acute with soft walls and a tendency to perforation, or it may be indurated with surrounding adhesions. By far the most common type of gastrojejunal ulcer is the penetrating ulcer. Perforation may lead to abscess formation, and the abscess may evacuate either anteriorly or posteriorly. Perforation into the colon produces a gastrocolic or gastrojejunocolic fistula in about 10 per cent. of cases.

The transverse colon may form the base of a crater, the ulcer having completely passed through the jejunal wall. (Jenckel and Schueppel report a case in which the ulcer had penetrated into the pancreas.)

Perforation is common. In 45 of Paterson's series of 62 collected cases,

there was perforation; Wright found 31 acute perforations in 135 cases, and Ssokolov reports that 25 per cent. of the cases he reviewed perforated.

Paterson gives an excellent classification of the types of perforation:

"Group 1.—Cases in which perforation into the general peritoneal cavity occurs.

"Group 2.—Cases in which, owing to the formation of localizing adhesions, perforation does not result in the escape of bowel contents into the general peritoneal cavity.

"(a) Cases in which the base of the ulcer becomes adherent to the abdominal parietes, so that perforation results in inflammatory exudation into the abdominal wall.

"(b) Cases in which the base of the ulcer becomes adherent to and perforates into a hollow viscus, the colon in the cases so far recorded."

None of our cases perforated into the free peritoneal cavity. Two had perforated into the transverse colon, showing gastrojejunal fistulae.

The greater number of cases fall into group 2, according to Ssokolov, particularly 2 (b).

Recurrence.—Aside from the tendency to perforation, gastrojejunal ulcers are quite likely to recur, as illustrated by numerous cases in the literature, in which three, four, and even six operations have been performed for recurrent ulcer, sometimes at very short intervals. In fact, in the cases which manifest this tendency to recurrence, the first gastrojejunal ulcer usually develops shortly after the original gastro-enterostomy, and the subsequent ulcers at correspondingly short intervals. This may point to an infective origin with failure to discover and remove the primary focus, or it may be used as an argument for the theory of "personal idiosyncrasy" or ulcer diathesis.

One of our cases had had a gastrojejunal ulcer following a gastro-enterostomy for duodenal ulcer with a later recurrence of another gastrojejunal ulcer following the excision and reconstruction of the gastro-enterostomy before coming to us, and at our operation showed a gastrojejunal ulcer at the stoma and a jejunal fistula in the proximal loop of the jejunum about two inches from the stoma, indicating that there had also been a jejunal ulcer there which was obliterated by the formation of the fistula.

In two of our patients gastro-enterostomy was done originally by us for duodenal ulcer. In one case the ulcer was also excised with the cautery and in the other nothing was done to the ulcer itself. In both cases the gastro-enterostomy was taken down, the gastrojejunal ulcer being removed with it, and the alimentary canal restored to its original course. In both cases duodenal ulcers have apparently recurred.

Etiology.—The etiology of gastrojejunal ulcers is still in a state of hypothesis. The supposed causes which find the largest number of supporters are (1) sudden exposure of the jejunum to hyperacid gastric contents; (2) the use of unabsorbable sutures and Murphy buttons (now rare); (3) operative trauma to the mucosa, by use of heavy clamps, etc.; (4) infection. Many surgeons believe that certain individuals have a personal idiosyncrasy or familial tendency to ulcer. Erdmann and Carter cite one case with seven operations for marginal ulcer, although all trauma and

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foci of infection were eliminated, which seems to point to idiosyncrasy. Huguët and Cole, however, remark that "idiosyncrasy" probably means reinfection at a new site from an undiscovered primary focus.

Other factors mentioned in the literature as contributing to the development of this unfortunate sequela to gastro-enterostomy are: (1) carelessness in post-operative diet and post-operative medical supervision; (2) the same causes which produced the original ulcer; (3) type of operation used (particularly frequent after von Eiselsberg pyloric exclusion); (4) breaking down of hæmatomas; (5) local irritations; (6) syphilis; (7) chemical changes; (8) faulty operative technic, particularly the placing of the anastomosis too high (Woolsey); (9) racial tendency to ulcer in the Hebrew (Eustermann); (10) excessive smoking, alcoholism, and excessive use of condiments; (11) fatigue and exposure; (12) too small an opening of the anastomosis (Pfeiffer and Smyth); (13) inclusion in the gastro-enterostomy of part of the inflamed gastric wall; (14) retrograde invagination of the jejunum into the stomach (Blond); (15) circulatory interference in the attached jejunum, due to tension, arteriosclerosis, or injury to the mucous membrane, either at the time of operation, or later, by hard particles of food (Tiegel); and (16) circular spasms of the gastric and duodenal musculature (Blond).

This multiplicity of hypotheses indicates the complexity of the problem with which we are dealing, and emphasizes the fact that the etiology of these ulcers is really unknown.

Primary ulcer of the jejunum is so rare that little light can be thrown on the subject from this angle.

Von Roozer, who first suggested the possibility of primary ulceration of the jejunum (1909), called attention to the fact that unless there has been artificial anastomosis, the jejunum is remarkably free from ulceration. Richardson, in 1922, collected twelve cases from the literature and added two of his own. Since then Fischer has reported another case. Of Richardson's 12 cases, 9 occurred between the ages of forty-five and sixty-three, and 10 were in men. Perforation occurred ten times in the 12 cases. In 5 cases which came to autopsy, the jejunal ulcer was the only one present in the intestinal tract. In 6 cases confirmed by autopsy or operation, the stomach and duodenum were negative; 2 cases showed a lesion of the duodenum or stomach; and in 4 cases, the condition of these organs was uncertain.

Richardson concludes, in discussing the etiology of these primary ulcers of the jejunum: "No definite etiology may be assigned to them. It is possible that in so rare a condition there may be almost as many causes as cases."

Hyperacidity.—That the sudden exposure of the jejunum to hyperacid gastric contents (to which it is unaccustomed under normal conditions) may lead to irritation of the mucosa with resultant ulceration is agreed by practically all authors.

Kocher is of the opinion that the acid gastric juice may stimulate circular contractions of the jejunum just below its junction with the stomach, with the formation of a kind of cul-de-sac in which the stay of the gastric juice may be prolonged and so cause ulceration.

Paterson says: "Jejunal ulcer following gastrojejunostomy is the result of a toxic agent or poison which so injures or kills the cells of the jejunal mucous membrane that

they are readily digested by the intestinal juice. The toxic agent usually present is free hydrochloric acid, but possibly other toxic substances may be present, and either may increase the effect of the other. Thus a small percentage of free hydrochloric acid in the jejunum, which by itself would not cause ulceration, may in the presence of some other toxic agent produce ulceration.

"The circumstances under which free hydrochloric acid may be present in the jejunum are (1) hyperacidity of the gastric contents so that the bile and pancreatic juice are unable to neutralize completely all the acid entering the jejunum; (2) normal percentage of hydrochloric acid in the gastric juice, but excessive secretion, so that the amount of hydrochloric acid discharged into the jejunum is greater than can be neutralized; (3) diversion of the course of the bile and pancreatic juice, so that part of the jejunum is exposed to the action of the gastric contents unmixed with bile and pancreatic juice, as after operations of the "Y" type, and gastrojejunostomy with entero-anastomosis; (4) normal acidity and amount of gastric secretion, but incomplete neutralization in the jejunum owing to temporary diminution of the flow of bile, and of the secretion of pancreatic juice."

Judd reports that in more than 60 per cent. of the cases of gastrojejunal ulcer seen at the Mayo Clinic, the acids were high, even after gastro-enterostomy.

Hoguet and Cole raise the question whether hyperacidity is essential to the development of secondary ulcer, or whether this condition exists only after the appearance of ulcer.

Balfour believes that the recurrence of ulcer is directly associated with failure to reduce the acidity, to maintain this reduction, and to provide adequate drainage; and that for these reasons the stoma should reach the lowest point of the greater curvature.

Advocates of partial gastrectomy rather than gastro-enterostomy as the initial procedure (Lewisohn, Strauss, and many German authors) claim that this insures anacidity and precludes the possibility of gastrojejunal ulcer. Ssokolov, however, states that gastrectomy does not prevent peptic ulcer of the jejunum, as it occurred in 4.32 of the cases in his series in which this operation was done.

Sherren points to the rarity of gastrojejunal ulcer in women, whose acidity is lower than that of men, as proof that hyperacidity has much to do with the occurrence of secondary ulcers.

Walton, in studying acidity before and after gastro-enterostomy, found it reduced in cases of gastric ulcer, but not as consistently in cases of pyloric or duodenal ulcer. This may account for the fact that the incidence of gastrojejunal ulcer is so much greater following operation for duodenal and pyloric ulcer. In Balfour's series of 139 cases, the original lesion was duodenal in 130.

Sherren has notes on pre- and post-operative test meals in 285 cases of chronic duodenal ulcer; 37 of these showed little or no reduction in gastric acidity, and in all of these some abnormality was noted (adhesion to the gall-bladder or liver, opening nearer the pylorus than usual, smaller than usual, ante-colic operation, or bruising around the anastomosis). Seventeen of the 37 have had further symptoms; 5, jejunal ulcers. In 131 cases free hydrochloric acid was absent and the total acidity low; none of these had return of symptoms. In 65 cases there was great reduction, but not abolition of free hydrochloric acid; these patients are all in excellent condition. In 52 cases the free hydrochloric acid was reduced to normal, 5 of these developed symptoms, but none had a jejunal ulcer. These data show a definite relationship between gastric acidity and secondary ulcer.

Douglas states that ulcers do occur with low acidity, and that he has had patients with high acidity who do not develop them.

MacGuire cites a case in which marginal ulcer developed after practically all of the acid-bearing portion of the stomach had been removed.

Lewisohn has reported a case in which the gastric contents were hypoacid.

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We have had two ulcers in the gastric stump after partial gastrectomy, one in a patient with low acid and one in a patient with no free hydrochloric acid.

The location of the marginal ulcer—usually close to the stoma, or in the stoma itself—favors the argument that the ulcer is due to the chemical irritation of the jejunum by gastric juice not neutralized by the alkaline duodenal contents.

The use of unabsorbable sutures and of Murphy buttons has been shown both clinically and experimentally to be a factor in the production of secondary ulcer, and has therefore been largely discarded. That they are not the sole factor is evident from the continual occurrence of ulcers in which only absorbable sutures have been used.

Operative Trauma.—The use of heavy clamps should be avoided, and the technic so carried out as to minimize trauma. More careful attention to suture material and to the details of operative technic has definitely diminished the incidence of secondary ulcers.

Infection.—Infection and hyperacidity, factors over which the surgeon has less control than of the strictly mechanical factors just discussed, remain the important ones. Deaver, Woolsey, Pfeiffer and Smyth, Balfour, Judd, and many others emphasize the necessity of removing all foci of infection at the time of the primary operation, if gastrojejunal ulcers are to be avoided. Particular attention should be directed to the gall-bladder and appendix, and certain authors (Deaver, Woolsey, Erdmann, Pfeiffer and Smyth) advocate cholecystectomy coincident with gastro-enterostomy if there is any indication that the gall-bladder is diseased. It is useless to remove the gastric or duodenal ulcer, and not remove its cause. To do so is merely to invite secondary ulceration.

Type of Operation.—It is difficult to determine just how much relation exists between the type of original operation and the development of marginal ulcers. The majority of writers agree that the incidence is greater following anterior than posterior gastro-enterostomy, and particularly high after the von Eiselberg exclusion.

Judd reports a case following sleeve resection; Hoguet and Cole, following the Polya operation. They believe that in this case an inflamed appendix and colon constricted by adhesions might have caused both the original and the secondary ulcer. We have one recurrence of a gastric ulcer directly on the suture line following midgastric sleeve resection for a large gastric ulcer.

Friedmann found that of 120 cases subjected to a Billroth I or II operation, 8 developed gastrojejunal ulcer. In these the resection was too small. Forty-three cases of gastrojejunal ulcer followed a von Eiselberg gastro-enterostomy, or the Riedel-Payr method, according to this author.

Ssokolov reports cases following both anterior and posterior gastro-enterostomy, also following Roux's method, and in one case following a Billroth II. He also states that gastrectomy does not prevent gastrojejunal ulcer, as the latter occurred in 4.32 per cent. of his cases in which this operation was done.

After von Eiselberg's unilateral exclusion of the pylorus, Ssokolov found the inci-

dence to be 20 per cent.; von Haberer reports it as 17 per cent. Denk, Takats, Carman, and Keppich likewise condemn it.

Ochsner stated in 1922 that in every case in which he had operated for jejunal ulcer, the anastomosis was not at the lowest point of the stomach, thus allowing an accumulation of acid or decomposing gastric contents, which corresponds to the condition which produced the original duodenal ulcer.

Peterson condemned the "Y" type of operation because, after this, the bile and pancreatic juice enter the jejunum some inches below the anastomosis, so that this and several inches of jejunal mucous membrane are exposed to the action of unneutralized gastric contents. Twenty-four per cent. of gastrojejunal ulcers followed this type of operation.

Symptoms.—Gastrojejunal ulcer, like gastric ulcer, may in certain cases run a symptomless course until sudden severe pain at the level of the umbilicus indicates the onset of perforation which, as we have stated, is not uncommon. The majority of cases, however, produce symptoms, and in these the onset is gradual and varies from a few days after operation to twenty-five years. There is often a period of comfort for six months or one year or several years following gastro-enterostomy, and then recurrence of a digestive complaint.

The symptoms may arise from a few months to several years after operation. A number of cases reported in the literature which did not give rise to disturbing symptoms till ten or twelve years after operation make it evident that one should not count his "cures" too soon.

Judd reports a case in which a definite secondary ulcer was demonstrated by X-ray five weeks after the original operation.

The symptoms of the secondary ulcer are often similar to those of the original ulcer: burning or gnawing pain after meals, which may or may not be relieved by food or alkalies. The pain is usually to the left of the midline, and considerably lower than that of ulcer of the stomach or duodenum. It may radiate to the lower abdomen, or to one or both iliac fossæ. As regards intensity of the pain, there is divergence of opinion, many authors stating that it is more intense than that associated with the original ulcer, sometimes becoming "unbearable"; but others finding it to be less intense. In our experience it is more severe and much less amenable to medical management, the usual relief measures having only a very transitory effect. All agree that there may be periods of remission.

Occasionally there is associated anæmia, and a stooping posture. Hæmatemesis and passage of blood from the bowel are sometimes observed.

Szemoe believes the periodicity of the symptoms and their tendency to become latent is one reason for postponing operation until medical treatment has been given a fair trial. It is also a reason why end-results should not be considered conclusive until several years after operation.

In advanced cases with exudate, there may be a palpable tumor.

There may or may not be hyperacidity. If there is, this should be reduced before operation, and it is important to determine the amount of free hydrochloric acid in outlining treatment.

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Lennander says there are no "pain-perceiving nerves in the stomach and intestine, and that, therefore, ulceration is painless until it invades the peritoneum, making determination of exact time of onset difficult."

Occasionally the patient may complain of pain on turning or twisting the body, raising the arms, or during a lifting strain, and this symptom is usually evidence of adhesions involving the abdominal parietes. (Eustermann.)

Although the relationship between discomfort and food intake is not always definite, it is usually sufficient to point to a lesion associated with gastric function.

In a certain group of cases, which Eustermann calls the "intestinal type", symptoms are all referred to the lower abdomen, and bear no relation to food. The pain is often associated with bloating or defecation, occasional diarrhœa, or severe constipation alternating with diarrhœa, at times presenting a clinical picture similar to that of intestinal obstruction, and the error of interpreting the symptoms as due to "irritable colon", colitis, etc., should be guarded against.

A definite mass is sometimes palpable in the umbilical region. Tenderness may be localized or diffuse. In patients with marked obstruction, visible peristalsis is found on physical examination.

The symptoms which arise in connection with gastrojejunal fistulas, the extreme stage of the ulcer, will be discussed separately.

X-ray Findings.—Case, approaching the subject from the röntgenologist's point of view, says:

"The one direct sign of a gastrojejunal ulcer is the evidence of an ulcer crater in relation to the stoma. One is able to see this only very rarely. More often there is a deformity about the stoma, narrowing and irregularity of the jejunum, and evidence of fixation at the site of the anastomosis, all of which are in contrast to the lack of deformity and perfect pliability of the jejunal walls and mobility of the stomach at the site of the anastomosis found in normal cases.

"Indirectly, dilation of the stomach and duodenum, delay in gastric clearance, and unusual activity of the gastric musculature, manifested either by spasm or by hyperperistalsis, suggest the presence of an anastomotic ulcer.

"There is a characteristic general excitation of the stomach and upper bowel recognizable by the experienced röntgenologist. Motor irritation may be suggested by (a) extreme, boardlike contractions of the stomach; (b) serration of the greater curvature; (c) spasm of the new stomach outlet, sometimes amounting to a total long-continued occlusion of the anastomosis, and (d) spastic contractions of the adjacent jejunum, recognizable by the fact that the first bolus of barium that passes is followed immediately by an occlusion that is spastic in nature and may or may not result in a prolonged gastric clearance. In other cases, there is often no disturbance in gastric mobility."

Tenderness on pressure over the gastro-enterostomy opening is highly suggestive. In observations made four hours after the administration of the barium meal, tenderness over a residual fleck of barium at the region of the stoma has proven of marked diagnostic value in our hands.

Carman calls attention to the deformity of contour about the stoma, exaggerated peristalsis, barium retention, spasticity or enlarged stomach, and the fact that the gastro-enterostomy is not freely patent.

Balfour says that fluoroscopic examination will be positive in 95 per cent. of cases.

Moore and Marquis find that the greatest difficulty in the X-ray diagnosis of

gastrojejunal ulcer is its differentiation from an improperly performed gastro-enterostomy. They mention two groups of X-ray findings in gastrojejunal ulcer:

"(1) Those indicating an abnormal condition in the anastomosed stomach, such as retention, hyperperistalsis, a large stomach, gastric spasticity, and duodenal dilation; and (2) deformities around the stoma, such as irregularity of the jejunum, a scanty flow through the opening, and fixation of the anastomosis site. It is of the greatest aid to the röntgenologist to know what type of gastro-enterostomy was performed."

Diagnosis.—When an interval of relief after gastro-enterostomy is followed by a return of symptoms referable to the digestive tract, a diagnosis of gastrojejunal ulcer is to be seriously suspected, although of course in a few cases they indicate reactivation of the original ulcer, the development of malignancy, or distress due to improper function of the gastro-enterostomy, particularly too rapid emptying of the stomach with jejunal dilatation. X-ray examination affords the most accurate method of differential diagnosis.

Treatment.—Preventive Measures.—The importance of these cannot be overemphasized. Gastro-enterostomy should not be undertaken lightly, and, once performed, careful and particularly persistent medical management post-operatively will greatly reduce the incidence of gastrojejunal ulcers.

Medical Management.—If a gastrojejunal ulcer is recognized clinically, many authors suggest, and we firmly believe, that medical management should be given a fair trial before resorting to surgery: (1) with the hope of affording relief; (2) to confirm the diagnosis; (3) to make the patient a better operative risk, if operation proves necessary, by first reducing the hyperacidity. We have now ten cases which are being handled quite satisfactorily with medical management from five years to six months.

Paterson considers the possibility of permanent relief by medical treatment very inconclusive, and states that although jejunal and gastrojejunal ulcers occasionally heal, the process of healing is apt to result in a condition requiring surgical intervention. Notwithstanding this, he believes, and we agree with him, that before an operation is performed for the secondary ulcer, the patient should undergo a course of careful dietetic and medical treatment.

If under medical treatment by diet, rest, and neutralization, pain disappears and the gastric acidity becomes diminished, this mode of treatment should be continued for at least six months. If, however, pain and hyperacidity persist, and if there is evidence of hypersecretion or gastric stasis, a continuance of medical treatment is of course futile. Medical treatment is more effective in those cases where a high acidity is found with the onset of symptoms.

Surgical Procedures.—If the clinical symptoms of ulcer have been verified by X-ray, and if these are not promptly relieved by medical measures, and the relief maintained, early and radical operation—partial gastrectomy—is the procedure most likely to be followed by complete relief of symptoms and cessation of ulcer development, although formerly it was customary to undo many gastro-enterostomies and make a new anastomosis, or to excise the ulcer and reconstruct the gastro-enterostomy. The percentage of recur-

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rence following these measures has been high, and in many of the reported cases after the patient has been subjected to several gastro-enterostomies, it has eventually become necessary to perform a radical operation. It is therefore wiser to resort to partial gastrectomy at once, but only if conditions for its performance are favorable.

The alternatives are (1) excision of the ulcer, when small, with enlargement of the original anastomosis; (2) cutting off the gastro-enterostomy, excising the lesion, closing the openings in the jejunum and stomach, restoring the alimentary tract to its original state; (3) pyloroplasty; and (4) jejunostomy.

Partial gastrectomy for gastrojejunal ulcer is often a difficult, time-consuming, and serious operation, and while it is undoubtedly productive of the highest percentages of maintained cures of this lesion, and has been the most satisfactory procedure in our hands, nevertheless, if applied in every case without regard for possible mortality factors, its death rate will be excessively high.

It is not possible to put in written words any set of rules adjustable to the variable factors which, when added to another variable factor, namely, the technical skill of the operator, make the operation one of greater or lesser risk. Nevertheless in general there are certain cases in which we know from our past experiences with them that the resection will be difficult. They are the patients who are still overnourished, with short fat-filled mesocolons which do not permit of ready delivery of the stomach. They are in the short individuals, who are also often difficult anæsthesia subjects. In such patients we still feel that excision of the gastro-enterostomy together with the stoma and closure of the stomach and jejunum, followed by dietary measures, will not result in the high percentages of complete relief which attends partial gastrectomy, but will at times be necessary if one would avoid an unjustifiable mortality. We have, as stated earlier in this paper, twice seen duodenal ulcer reappear following this procedure. In both cases the duodenal ulcer was found healed at the operation for the gastrojejunal ulcer, and recurred following excision of the gastro-enterostomy and restoration of the alimentary stream to its natural course. Both cases are progressing satisfactorily under medical management so far (one under treatment for two years, the other for six months), and we feel that they are suffering from the lesser of two undesirable states in that they were bad risks for partial gastrectomy.

The procedure of excising the ulcer and enlarging the stoma should be abandoned, since it has been followed by such a high percentage of ulcer recurrence, which is not remarkable because it in no way alters the pathological physiological processes which originated the gastrojejunal ulcer.

Pyloroplasty is applicable in the surgical management of this lesion only as an added step to excision of the gastro-enterostomy together with the ulcer and restoration of the alimentary canal to its original state. We have never employed it.

Jejunostomy should be reserved for those bad risk cases in which either partial gastrectomy or excision of the gastro-enterostomy stoma together with the ulcer would be an unjustifiable risk. We have not employed it in connection with gastrojejunal ulcer.

GASTROJEJUNOCOLIC FISTULÆ

The most unfortunate sequela of a gastrojejunal ulcer is a gastrojejuno-colic fistula, the first case of which was reported by Czerny four years after Braun published the first description of a jejunal ulcer. Verbrugge of the Mayo Clinic has recently (1925) made an exhaustive review of the subject.

He reports that 11.36 per cent. of the patients at the Mayo Clinic who had a gastrojejunal ulcer following gastro-enterostomy developed a gastro-jejuno-colic fistula also. Bolton and Trotter found that fistulæ develop in about 10 per cent. of cases of gastrojejunal ulcer, and Lion and Moreau report an incidence of 12 per cent. According to Verbrugge, .16 per cent. of all patients who have gastro-enterostomy develop fistulæ.

Two of our 16 cases had gastrojejuno-colic fistulæ.

Loewy, in 1921, compiled from the literature 76 gastrojejuno-colic fistulæ following gastro-enterostomy, and reported them in detail. At that time 185 cases of gastrojejuno-colic fistulæ from all causes had been reported. To these may be added 17 collected by Verbrugge, 14 not previously reported from the Mayo Clinic, and two from our clinic, making a total of 218 cases.

Fistulæ resulting from gastrojejunal ulcers represent the extreme stage of the evolution of these ulcers, and therefore the etiology must be considered that of the ulcer itself.

At operation many gastrojejunal ulcers are markedly adherent to the colon, due to the fact that when a gastro-enterostomy is done upon a patient with a short mesocolon and a low stomach, the colon lies just over the gastro-enterostomy stoma, particularly if the mesocolon has been attached to the stomach. If a gastrojejunal ulcer develops and is not operated on at this stage, a fistula soon results from the progress of the ulceration. "It is a remarkable fact that, immediately following the perforation, the jejunal ulcer is cured, the mucous membrane becomes normal in appearance, and the walls of the fistula, as described by Gosset, seem as 'if they had been neatly cut out by a surgeon's hand'."

Pathology.—During the formation of a fistula,—that is, while the jejunal ulcer is perforating the intestinal coats—there may or may not be a localized peritoneal reaction. This will partly determine the extent of the adhesions which will be found at operation, which may be entirely absent (Gosset), slight, or so extensive as to make operative procedure very difficult.

The manner in which the jejunal ulcer penetrates, and the technic of the gastro-enterostomy, particularly the fixation of the mesocolon to the stomach, will also influence the extent of the adhesions.

The fistula may be gastrocolic, jejunocolic, or gastrojejuno-colic. The ulcer may develop on the wall of the jejunum opposite the gastro-enterostomy

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stoma; it often involves both gastric and intestinal sides of the suture line. Cases have been reported in which the ulcer developed 10 cm. from the stoma and yet produced a fistula. We have had one such case found in the course of gastric resection for gastrojejunal ulcer at the stoma.

The fistulæ are usually single. Even multiple ulcers rarely give rise to more than one fistula. The width of a fistula may vary from 1 mm. to 10 cm. The direction and length are also variable, and "the orifice may be hidden in folds of the mucosa, constituting a valve-like apparatus which may at times complicate the symptoms." The mucous membrane covering the fistulous tract is usually not markedly abnormal, but the efferent branch of the jejunum is often dilated, congested, thickened, and hypertrophied, due to constant irritation, at first by the acid contents of the stomach, and later by the fecal material from the colon.

Narrowing or stricture of the colon at the orifice of the fistula is not uncommon, and in extreme cases will cause distention of the cæcum with signs of intestinal obstruction, which may lead to erroneous diagnoses.

Symptoms.—These may begin from two and a half months after operation (von Eiselberg) up to twelve years later (Roux). In the series reported by Verbrugge, the minimal interval was nine months, and the maximal five years and four months.

The onset may be marked by sudden diarrhœa, by abdominal cramps and colics accompanied by vomiting of fecal material, or it may be insidious. Foul eructations and loss of weight and anæmia are significant. Pain is rare, inconstant, and variable, but stricture of the colon may cause obstructive symptoms. Loss of weight, which is apt to be rapid and considerable, often makes the operative risk poor.

Physical signs seem to be of little value, because of their variability.

Diagnosis.—The symptoms just enumerated, plus a history of gastroenterostomy and possibly of jejunal ulcer, make the diagnosis of gastrojejunocolic fistula comparatively easy. In doubtful cases certain diagnostic aids are available: the use of colored meals which appear rapidly in the stools; the recovery of colored material by gastric tubage after a colored enema; insufflation of the rectum provoking rapid distention of the stomach; gastric lavage producing loss of fluid, and, of course, X-ray examination. Firth considers the X-ray pathognomonic, but in eight of the Mayo Clinic cases it was negative, and in one, doubtful.

Cividali has given the X-ray characteristics as follows: irregular contour of the stomach, signs of perigastritis with limited mobility of the stomach; passage of bismuth into the colon; presence of bismuth in the descending colon and sigmoid, and absence in the ascending colon; possibility of provoking the passage of bismuth from the colon into the stomach by palpation, and presence of bismuth in the stomach following a bismuth enema. In a case recently seen by us, the first fluoroscopic examination showed barium passing from the jejunum into the colon, but this phenomenon could not

be reproduced in later observations. Subsequent operation showed the presence of the fistula.

Recurrence.—The fistulae, like the ulcers which lead to their formation, have a tendency to recurrence, as pointed out by Loewy (11.1 per cent.).

Treatment.—Unless surgical measures are instituted, the outcome is likely to prove fatal in the majority of cases. The preventive measure of diminishing the incidence of gastrojejunal ulcers is of course the desired end. Fistulae may be at least guarded against by making a high opening in the posterior leaf of the gastrocolic omentum, so that the anastomosed jejunum as it passes through this opening is held away from the transverse colon.

Pre-operative treatment, though sometimes advisable, should not be long continued, as the patient will continue to lose weight and the operative risk be thus increased. Enemas should be avoided. The poor condition of patients with gastrojejunal ulcer and colonic fistula, together with technical difficulties consequent to the adhesions, as well as the danger of soiling from colon contents, mitigate strongly against extensive operative procedure. Excision of a gastro-enterostomy with the gastrojejunal ulcer, together with closure of the fistulous tract will, we believe, be followed by the lowest mortality and, in spite of the possibility of recurrence of the original duodenal ulcer, as occurred in two of our cases, is the most justifiable procedure.

CONCLUSIONS

A majority of the ulcers recurring after gastro-enterostomy are gastrojejunal ulcers and not recurrences of the original ulcers. There are many more gastrojejunal ulcers in existence than we have heretofore assumed. They are the most dangerous of all types of ulcer, and so serious and frequent are their complications that they demand very early discovery, and with failure to obtain relief and low acidity with medical treatment demand prompt and the most complete eradication.

PROGRESSIVE GANGRENOUS ULCERATION OF THE ABDOMINAL WALL

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IN *Surgery, Gynecology and Obstetrics* for May, 1924, Dr. Thomas Cullen¹ described an extensive serpiginous ulceration of the abdominal wall and in the Chicago number of *Surgical Clinics of North America* for June, 1924, Dr. Frederick Christopher² reported a similar case. At the meeting of the American Surgical Association in Washington in May, 1925, Dr. George Brewer³ reported two of his own cases and spoke of five other cases, two of which were Christopher's mentioned above. In addition to these there is a report by Dr. Tomosuke Mayeda⁴ in *Deutsch. Ztschr. f. Chir.*, for 1926.

On May 11, 1927, there was admitted to my service in the University Hospital of Baltimore, a man with a large, progressive and gangrenous ulcer occupying the entire left half of his upper abdominal wall and extending well up on the chest. He was sent in by Dr. R. W. Patterson, of Clarksburg, W. Va. He had been operated on at his home in West Virginia on January 5, 1927, for what was diagnosed as abscess of the abdominal wall. This incision was on the right side and about opposite the umbilicus. He was operated on again on January 19, and a second abscess to the left of the midline drained. This abscess contained about 100 c.cm. of pus with a colon odor. Following this the history is that four small pimples about the size of a grain of wheat appeared adjacent to the wound. The skin became brown in color, but the physicians did not pay much attention to this at the time. These pimples ruptured spontaneously and some pus escaped. These infected areas spread rather rapidly in all directions until the larger portion of the entire left abdominal wall was involved. Many different antiseptics were tried, but in spite of all methods of treatment the infection spread. He was in the hospital for seventeen weeks and left the hospital with the process still extending. After leaving the hospital he went home and was treated by his physician for three weeks. The infection continued to spread, the patient's general condition became worse and he then went to another hospital near his home where the wound was treated for four weeks with Dakin's solution, but the ulceration continued to advance. He left the hospital and went home and on May 11, 1927, as stated above, was admitted to the University Hospital.

At this time the lower portion of the ulcerating surface had begun to heal. The middle portion of it was occupied by a large granulating surface and there was a long, spreading margin extending in a wide semicircle from the midline of the abdomen just above the navel onto the costal margin and chest wall and downward on the lumbar region to the crest of the ileum behind. This advancing margin presented a number of zones. There was a narrow strip of black, necrotic tissue adjacent to the ulcer. Just beyond this there was an oedematous, dusky red and swollen area about 6 or 7 cm. wide and beyond this the swelling gradually merged into normal looking tissue. The patient's general condition was bad. His morale was very low, he had lost a great deal of weight and his chief complaint was exquisite tenderness over the entire area when it was handled in any way. He was kept under observation and the area painted over several times a day with mercurochrome, but without any improvement.

May 17 he was taken to the operating room and, under gas anaesthesia, the entire advancing border of the ulcer cauterized. The cautery was thrust through the skin and a linear cauterization done parallel to the advancing ulcer and beyond the red, oedematous area. The strip of infected and necrotic ulcer was then excised by means of a scalpel and the denuded surface thoroughly cauterized. This arrested the ulcer, except in two small areas where evidently the cauterization was not carried beyond the advancing infection. Here, a semicircular, spreading ulceration developed and these areas were again cauterized one week later.



FIG. 1.—Appearance of lesion on admission.

Following this, there was no further spread of the ulceration. The surface was Dakinized and gradually cleaned up. Four weeks later, a small area was covered by pinch grafts taken from the thigh to determine whether or not these grafts would live on a surface that had been so heavily infected. The grafts behaved very satisfactorily and at intervals of a few days the entire ulcerated area was covered by pinch grafts. This was done at four different operations. The last grafting was done on July 18, 1927, and 140 pinch grafts were placed on various areas of granulating surface. Practically all of the grafts lived. They were taken from the anterior surface of the thigh under local

anaesthesia. He left the hospital on August 9, 1927. The entire wound at this time was practically healed. I heard from his doctor about a month later, at which time he reported that the patient had entirely recovered; that the ulcerating surface was completely healed; and that he had gone back to work.

The original condition of this man was diagnosed abscess of the abdominal wall and was said to be of unknown etiology. The scar left by the drain tract was about 5 cm. to the right of the midline and just above the level of the umbilicus. From his history he probably had a high appendix with a walled-off abscess which was adherent to the abdominal parietes.

Bacteriologically the study of the tissue removed in my own case threw no special light on the infection. Smears made at the time of operation showed numerous pus cells and Gram-positive cocci in chains. Culture showed a non-haemolytic streptococcus.

In Cullen's case "the only microorganism found was the streptococcus brevis."

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In Mayeda's case the formation of the ulcer was attributed to a bacillus resembling the diphtheria bacillus, which he believed reached the infected area from the appendix.

In Christopher's case, the ulcer followed drainage of an empyema and the "direct smear of the pus from the pleural cavity was reported; Gram-positive cocci in chains; long slender Gram-negative bacilli. The anaërobic culture revealed small round Gram-positive cocci in chains, resembling streptococci and Gram-negative bacilli. There was a very slow growth of hæmolytic streptococci on aerobic media."

In Brewer's cases a careful bacteriological study was made by Meleney and the organisms recovered from the infected area were injected into both guinea-pigs and rabbits. A pure culture of a non-hæmolytic streptococcus was gotten from the peritoneal abscess at the time of the operation for appendicitis. Later cultures made from the gangrenous ulcer showed a hæmolytic staphylococcus aureus and a



FIG. 2.—Removal of gangrenous and infected area with cautery.

diphtheroid bacillus. At this time the streptococcus was not found. "Subsequently a special study was made of the slough from the wound. A hæmolytic staphylococcus aureus and a diphtheroid bacillus were found again aerobically, while the anaërobic blood agar plates revealed a streptococcus which would not grow on the aerobic plates." Animal inoculation was done in order to show the relation of these organisms to the ulcer. The excised ulcer was carried to the laboratory in a sterile towel and the surface painted with iodine and incisions were made into this tissue just beyond the gangrenous margins. Direct smears from the tissues showed a large number of very small cocci. These organisms turned out to be a non-hæmolytic streptococcus. The hæmolytic staphylococcus and the diphtheroid bacillus were not found away from the gangrenous margins.

Animal experimentation showed rather conclusively that for the formation of these gangrenous, serpiginous ulcers in animals, two organisms were neces-

sary: the non-hæmolytic streptococcus and the hæmolytic staphylococcus aureus; "these when injected together, produced gangrene almost invariably, while these organisms injected separately did not. The streptococcus never, and the staphylococcus only rarely in small guinea-pigs." Brewer's suggestion of symbiosis, with the experimental work supporting it, is a very enlightening thing. These gangrenous ulcers resemble very closely much of the behavior of carbuncles and it is quite possible that the specific nature

of carbuncles is due to a combination of special strains of staphylococci and streptococci working together.

All of these ulcers resisted ordinary treatment. Almost every sort of germicide was used. These agents had a good effect upon the granulating surface of the ulcer, but did not control the advancing gangrenous edge. Neither heat, cold, light nor other types of radiation had the slightest deterrent effect upon the spread of the ulceration.



FIG. 3.—Ulcerated area after cauterization; clean and healthy. This surface was later covered with pinch grafts.

In each instance the spreading necrotic edge was controlled only by very drastic surgical measures. Cullen cut away the edge of the ulcer with a cautery, burning about a half inch from the ulcerated area. Christopher at first excised the margin with a scalpel, but bleeding was so profuse that he finally resorted to the cautery. Mayeda excised the margin. Brewer "circumscribed the entire diseased area, well beyond the lesion by an incision through the skin and entire thickness of the subcutaneous fat to the sheath of the rectus and aponeurosis of the external oblique muscles and packed this incision with gauze wet with a 1 per cent. solution of formalin. The sloughing process did not extend beyond this barrier."

In my own case, under general anaesthesia, I produced a gutter wound with the cautery, well beyond the cedematous area of the skin and then cut away the ribbon of infected sloughing material between this cauterized line and the margin of the ulcer and cauterized the raw surface.

PROGRESSIVE ULCERATION OF ABDOMINAL WALL

CONCLUSIONS

These carbuncular-like and spreading, gangrenous ulcers are probably more common than the literature would indicate.

The work of Brewer and Meleney suggests that a combination of special strains of streptococci and staphylococci may account for the peculiar and specific nature of the lesion.

Most of the reported cases have followed suppurative appendicitis with drainage and the ulceration developed in the majority of instances a week or more following operation and behaved very differently from ordinary wound infection complicating drainage.

These lesions resist all ordinary treatment and in every instance were controlled only by complete excision, isolation or destruction of the advancing infectious area.

The cautery is a very useful instrument in checking the ulcers.

The large denuded surfaces have healed in some instances without grafting, but grafts live very well on the granulating surfaces and shorten the period of convalescence.

REFERENCES

- ¹Cullen, Thomas S.: A Progressively Enlarging Ulcer of the Abdominal Wall Involving the Skin and Fat, Following Drainage of an Abdominal Abscess Apparently of Appendiceal Origin. *Surg., Gyn. and Obs.*, vol. xxxviii, No. v, May, 1924, p. 579.
- ²Christopher, F.: Severe Spreading Carbuncular Infection of Chest Wall, Following Rib Resection Under Local Anæsthesia. *S. Clin. N. A.*, vol. iv, pp. 795-810, June, 1924.
- ³Brewer, George Emerson: Progressive Gangrenous Infection of the Skin and Subcutaneous Tissues, Following Operation for Acute Perforative Appendicitis. *ANNALS OF SURGERY*, Phila., vol. lxxxiv, p. 438, September, 1926.
- ⁴Mayeda, Tomosuke: Eine seltsame Hautgeschwurbildung nach der Appendektomie. (A Strange Cutaneous Ulcer Formation Following Appendectomy.) *Deutsch. Ztschr. f. Chir.*, vol. cxcix, pp. 350-353, 1926.

SOLITARY CYSTS OF THE KIDNEY*

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FROM THE DEPARTMENT OF PATHOLOGY OF THE UNIVERSITY OF MARYLAND

CYSTS of the kidney were described by Fabry¹ of Hilden, the "Father of German surgery", who died in 1624, and Thomas Willis² the English clinician of the seventeenth century. Morgagni³ described the renal cysts.

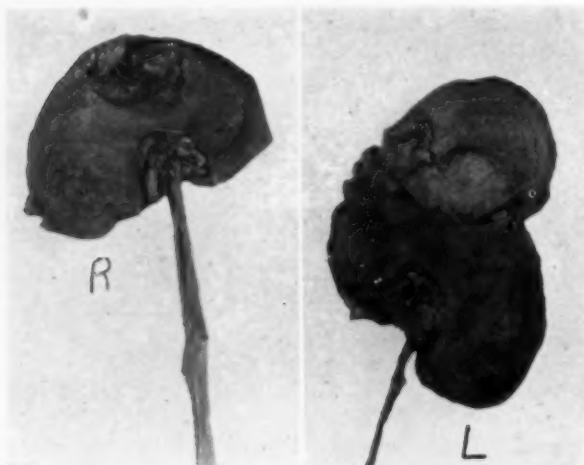


FIG. 1.—Case I. Large solitary cyst (capacity 800 c.c.) at upper pole of left kidney. Right kidney presents a cyst measuring 2.5 cm. in diameter at upper pole and a smaller cyst close to the hilum.

Rayer⁴ in 1837 classified different types of renal cysts, according to their contents. Cruveilhier,⁵ Lejars⁶ and Virchow⁷ made similar observation.

Laveren⁸ in 1876 made a clear distinction between single renal cysts and polycystic kidney. While Lancereaux in 1876 divided the large isolated cysts of the kidney into two classes—serous and hemorrhagic, of the former. Morris⁹

found 5 cases in 2610 autopsies at the Middlesex Hospital, London. In 1906, Simon¹⁰ was able to find but 52 cases reported in the literature.

Kretschmer,¹¹ in 1920, collected 47 cases appearing in the literature after Simon's review and added a case of his own.

Harpster, Brown and Delcher,¹² in 1923, tabulated but 95 cases. McKim and Smith,¹³ in 1924, collected 117 cases from the literature and added three of their own. Kretschmer,¹¹ Harpster¹² and McKim¹³ reviews do not include Kelly's and Burnam's¹⁴ 2 cases, Guiteras¹⁵ one case and Quinby's¹⁶ 3 cases. To the above 126 cases, may be added 15 cases which have appeared in the literature between 1923 and 1927. Viz: Lewis,¹⁷ G. G. Smith,¹⁸ Herrick,¹⁹ Swarz,²⁰ O'Neil,²¹ Gonczy,²² Delore and Mallet,²³ Petal and Mallet,²⁴ Viethen,²⁵ Santors,²⁶ Kirwin,²⁷ Alessandri,²⁸ Joseph²⁹ and Fullerton,³⁰ Fullerton collected but 98 cases from the literature.

As solitary serous cyst of the kidney is rare, the following 4 cases are reported, making a total of 145.

* Read before the North Central Branch, American Urological Association, October 14, 1927.

SOLITARY CYSTS OF THE KIDNEY

Etiology.—Three views are held: (1) That they are due to embryonal rests; (2) that they are due to failure of union between the glomeruli, and the collecting tubules; and (3) that they are retention cysts, due to constriction of the tubules by fibrous tissue or blocking of the glomeruli or tubules by desquamated and degenerated cells, favored perhaps by small hemorrhages.

In the development of the functional kidney or metanephros, it will be recalled that it has a double origin, the ureter, renal pelvis, calyces, and straight collecting tubules or ducts arising from the so-called ureteric bud, a diverticulum of the more primitive wolffian duct, and the coiled uriniferous or secretory tubules "Crystallizing," so to speak, from the metanephrogenic blastema into which the ureteric bud grows. The blind expanded end of the bud becoming the primitive renal pelvis, it now gives rise to the different successive generations or orders of straight collecting ducts. During this process, the metanephric blastema, which always caps the ampullæ or blind terminations of the last ducts formed, is divided in such a way that one part is raised or carried peripherally by the newly sprouting ones while the other part stays behind in the form of separate masses which lie in contact with the sides of the parent ducts. As this process is repeated every time a new generation of ducts is produced, generation after generation of potential uriniferous tubules are likewise laid down and accordingly arranged in successive tiers as one proceeds from centre to periphery. Soon after those metanephric masses are split off from the blastema, they round out to form what are known as "metanephric spheres". By the acquisition of the cavity they become converted into the "metanephric vesicle". By further growth



FIG. 2.—Case II. Solitary cyst of kidney 25 by 20 cm. extending from superior to inferior pole along the convex surface.

and change they attain the typical S-shaped stage, one end establishing continuity with the respective collecting duct, and the other forming the glomeruli capsule. Continued growth, extension, convolution and histological differentiation create the definite characters of the uriniferous tubules. Kampmeier²¹ has recently shown that every human individual during his foetal life normally passes through a period characterized by the presence of numerous cystic renal tubules. Such a normal physiological event, however,

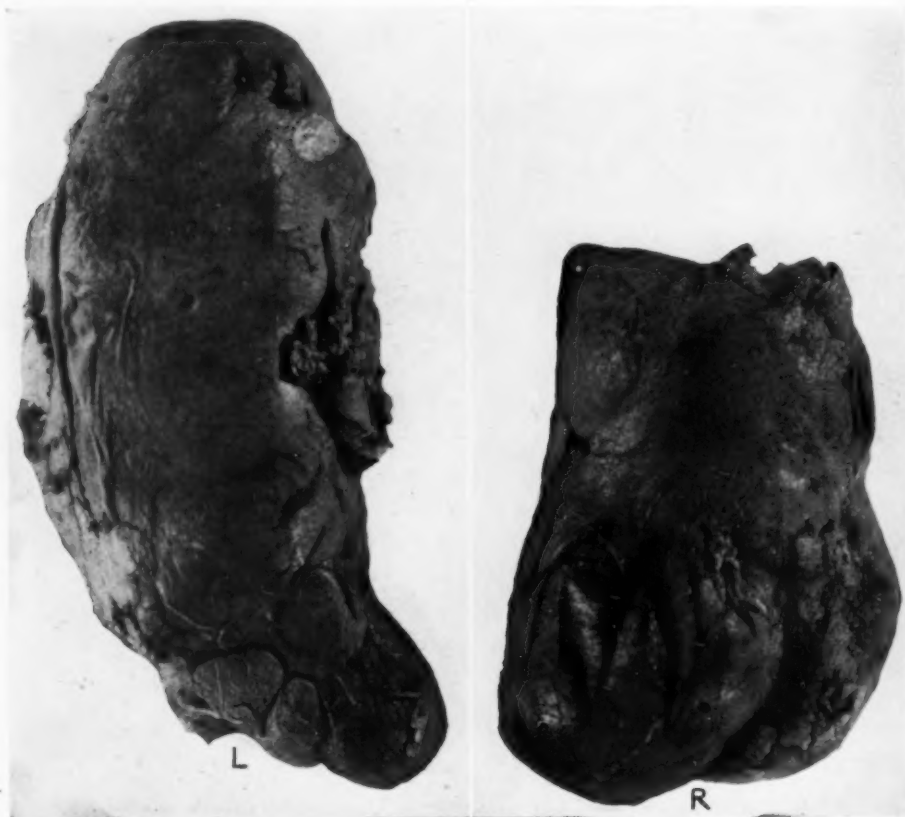


FIG. 3.—Case III. Solitary cyst lower pole of right kidney 15 by 10 cm. Lower pole of left kidney 8 by 4 cm.

may be converted into an abnormal or pathological condition if such tubules do not give way at the end of their allotted time but continue to grow and expand to the detriment of adjacent normal structures. Should one do this, it is readily understood how it might produce renal cysts.

Pathology.—Solitary serous cysts of the kidney are usually, unilateral, with the cyst located in the upper or lower pole, in a few of the reported cases it has occupied the anterior surface of the kidney or the hilum. The right kidney has been involved more frequently than the left. McKim and Smith found the lower pole involved in 51 and the upper in 21 instances, with 8 occupying the centre of the kidney. The size of the cysts vary from 30 c.c. to 16,000 c.c. Gonczy,²² with the average being 15 cm. in diameter.

SOLITARY CYSTS OF THE KIDNEY

The cyst wall is grayish-white in color with blood-vessels visible on its surface; on section the wall measures from 1 to 3 mm. in thickness, with the inner surface smooth and glistening, occasionally being multiloculated in character. The cyst wall is independent of the kidney capsule, but blends with the interstitial fibrous tissue of the renal cortex. Near the cyst the kidney substance usually shows pressure atrophy. No communication is found between the cyst and the kidney pelvis or calyces.

Microscopically the wall is found to be composed of fibrous connective tissue. Lauenar describes a lining made up of normal cell formation of the uriniferous tubules somewhat flattened in appearance. Carnil and Babinski describe a layer of pavement epithelium surrounded by a few cuboidal cells. Kelkeskamp found a complete lining of cuboidal epithelium. Bonneau and Hartmann found flattened epithelium with elongated cells which suggested endothelium, in some areas, while Lécène and Papin found cuboidal cells.

The majority of cases have shown no epithelial lining which may be due to ante-mortem or post-mortem changes.

The portion of the cyst wall which is nearest the kidney may show remnants of renal cortex. Small round-cell infiltration may be present, with calcareous deposits reported by a few observers. Brin³³ and Begg³⁴ who have collected 13 cases of solitary hemorrhagic cysts of the kidney from the literature, described the wall as being composed of three layers, (1) an inner layer of clots and fibrin; (2) a middle fibrous layer; and (3) an outer layer formed by renal parenchyma atrophied and sclerosed.



FIG. 4.—Case IV. Solitary cyst at lower pole measuring 6 by 4 cm.

CONTENTS

In the majority of cases the contents are described as clear serous fluids. Bloody fluids or clot being found in a few instances. In Kretschmer's case

the larger cyst contained old clotted blood and the smaller cysts, clear straw-colored fluid.

Associated Abnormal Conditions.—Complicating these cysts the following have been found: Hypernephroma, carcinoma of the kidney, papillary carcinoma of renal pelvis, horseshoe kidney, abnormalities of renal blood-vessels, bifid pelvis, hydronephrosis, renal calculi and tuberculosis of the kidney.

Age and Sex Incidence.—Age: The majority of cases reported were between thirty and sixty years, average forty-five years. Two were one year old, one was four and one eight years. The oldest was a male, age eighty-nine years, the cyst being successfully resected by Bockenheimer²⁵ from a horseshoe kidney.

Sex: The condition is more frequent in females, of the 145 recorded cases. Forty-one were in males, and 89 in females, and in 16 the sex was not stated.

CASE I.—F. V., white male, age sixty-two years. Clinical diagnosis: *Carcinoma of the bladder; hypertrophy of the prostate; Von Recklinghausen's disease.* Kidney.—Left: The left kidney has a large single cyst at its upper pole, which holds approximately 800 c.c. of clear fluid. Below the cyst, the surface of the kidney is of a bright red color and is finally granular in appearance. Right.—On the anterior surface of the upper pole is seen a cyst measuring 2.5 cm. in diameter, and on the lower pole close to the hilum, a small cyst measuring 1 cm. in diameter is seen. The surface of the kidney is finally granular in appearance, with the pelvis and calyces markedly dilated. The right ureter is markedly dilated from the bladder wall to the uretero-pelvic junction measuring from 1.5 to 2 cm. in diameter.

Microscopically.—Section from the cyst wall showed it to be composed of fibrous connective tissue.

Anatomical Diagnosis.—Carcinoma of the bladder involving the base and lateral wall, obstructing the right ureteral orifice; hydro-ureter, right; hydronephrosis, right; solitary serous cyst of the left kidney.

CASE II.—Museum No. E—30—51,628 C. White female, age forty-five years. *Nephrectomy by Doctor Ashby for tumor of the kidney.* Kidney.—There is a large cyst extending from the superior to inferior pole along the convex surface which measures 25 by 20 cms. (after fixation in formalin). The wall is grayish-white in color with numerous blood-vessels visible on its surface. It is filled with clear fluid.

Microscopically.—Section of the wall is composed of fibrous connective tissue, with a few small round cells infiltrating in a disorderly fashion between the connective-tissue cells.

CASE III.—Museum E—7—51,628 B. Autopsy No. 290. Colored male, age twenty-five years. Clinical diagnosis: *Typhoid fever.* Kidneys.—At the lower pole of each kidney there is a large cyst. The right measuring 15 by 10 cm. and the left 8 by 4 cm. The walls are thin and of a grayish-red color. They are filled with blood-tinged fluid.

Microscopically.—Sections show adult fibrous connective tissue with a few blood-vessels filled with red blood-cells.

CASE IV.—Museum E—25—51,628. *Nephrectomy by Doctor Winslow.* Kidney.—The kidney shows a large cyst at the lower pole which measures 6 by 4 cm., which is grayish-red in color. A few blood-vessels are visible on its surface. It is filled with turbid fluid. The kidney is dark red in color, with a granular surface.

Microscopically.—Section from cyst wall shows a thick layer of fibrous connective tissue with a moderate small round-cell infiltration. Section from kidney shows chronic diffuse nephritis.

SOLITARY CYSTS OF THE KIDNEY

DISCUSSION

From a review of the literature and a study of the four cases reported above, it is the opinion of the writer that polycystic kidney, solitary serous cyst of the kidney and solitary hemorrhagic cyst of the kidney are all the result of congenital malformations of the kidney and that the solitary hemorrhagic cyst is formed in the same way as the solitary serous cyst.

BIBLIOGRAPHY

- ¹ Fabry: Quoted by Kirwin.²⁷
- ² Willis, Thomas: Quoted by Kirwin.²⁷
- ³ Morgagni: Quoted by Kirwin.²⁷
- ⁴ Rayer, P. F. O.: *Traité des maladies des reins et des alterations de la secretion urinaire*. J. B. Bailliere, Paris, 1839-1841.
- ⁵ Cruveilier, Jean: *Traité d'anatomie pathologique*. J. B. Bailliere, Paris.
- ⁶ Lejars, Felix: *Du gros rein polycystique de l'adulte*. Paris Thesis, No. 154, 1888.
- ⁷ Virchow: *Virch. Arch. f. Path. Anat.*, vol. xlv.
- ⁸ Laveren, A.: *De la degeneration kystique des reins chez l'adulte*. *Gaz. hebdomadaire de med. et de Chir.*, 2^e me series, December 1 and 8, 1876, vol. lxiii, pp. 756 and 776.
- ⁹ Morris, H.: *Surgical Diseases of the Kidney and Ureter*, 1923, vol. i, p. 637.
- ¹⁰ Simon, J.: *Thèse*, Paris, 1906.
- ¹¹ Kretschmer, H. L.: *Solitary Cysts of the Kidney*. *Jour. Urol.*, 1920, vol. iv, p. 567.
- ¹² Harpster, C. M., Brown, T. H., and Delcher, S.: *Solitary Unilateral Large Cysts of the Kidney*. *Jour. Urol.*, 1924, vol. xi, p. 157.
- ¹³ McKim, G. F., and Smith, P. G.: *Solitary Serous Cysts of the Kidney*. *Jour. Urol.*, 1924, vol. xii, p. 635.
- ¹⁴ Kelly, H. A., and Burnam, C. F.: *Diseases of Kidneys, Ureter and Bladder*, 1914, vol. ii, p. 272.
- ¹⁵ Guiteras, R.: *Urology*, 1912, vol. i, p. 493.
- ¹⁶ Quinby, W. C.: *Reports of the Meetings of the New England Branch of the Am. W. Assn.*, 1907 and 1908.
- ¹⁷ Lewis, N. D. C.: *Kidney Malformations in the Mentally Disordered*. *Am. Jour. of Psych.*, 1923, vol. iii, p. 73.
- ¹⁸ Smith, G. G.: *Case of Solitary Cyst of the Kidney*. *Boston Me. and Surg. Jour.*, 1924, vol. lxi, p. 691.
- ¹⁹ Herrick, F. C.: *Discussion of McKim's Paper*. *Jour. of Urol.*, 1924, vol. xii, p. 665.
- ²⁰ Swarz, E. O.: *Malignant Papillomata of the Renal Pelvis Associated with Solitary Cyst of the Kidney*. *Jour. of Urol.*, 1925, vol. xiii, p. 295.
- ²¹ O'Neil, R. F.: *Solitary Serous Cyst of the Kidney*. *Jour. of Urol.*, 1925, vol. xiv, p. 269.
- ²² Gonczy, I.: *Case of Large Retention of Kidney Simulation Tuberculous Peritonitis*. *Med. Chir.*, 1925, vol. lxxv, p. 688.
- ²³ Delore, and Mallet, Guy: *Large Serous Kidney Cyst and Partial Nephrectomy*. *Lyon Chir.*, 1925, vol. xxii, p. 3.
- ²⁴ Patel, and Mallet, Guy: *Case of Large Suppuration Cyst of the Kidney*. *Jour. d'Urol.*, 1925, vol. xix, p. 316.
- ²⁵ Viethen, H.: *Solitary Cyst of Horseshoe Kidney*. *Zentralbl. f. Chir.*, 1926, vol. ciii, p. 2655.
- ²⁶ Santors, E.: *Solitary Cyst of the Kidney*. *Riforma Med.*, 1926, vol. xlii, p. 267.
- ²⁷ Kirwin, T. J.: *Calcified Renal Cyst*. *Jour. of Urol.*, 1926, vol. xv, p. 273.

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- ²⁸ Alessandri, Prof.: Removal of Solitary Cyst from the Lower Pole of the Kidney. *B. Jour. of Surg.*, 1926, vol. xiv, p. 175.
- ²⁹ Joseph, M.: Case of Large Solitary Cyst of Kidney. *Jour. Urol.*, 1927, vol. xvii, p. 245.
- ³⁰ Fullerton, A.: Solitary Cyst of the Kidney. *Br. Jour. Surg.*, 1927, vol. xiv, p. 629.
- ³¹ Kampmeier, O. F.: A Hitherto Unrecognized Mode of Origin of Congenital Renal Cysts. *Surg., Gynec. and Obstet.*, 1923, vol. xxxvi, p. 208.
- ³² Cassolili, C.: *Rivista Ospedal*, Roma, 1917, vol. vii, p. 151.
- ³³ Brin: *Encycl franc d Urologie*, vol. iii, p. 19.
- ³⁴ Begg, R. C.: Solitary Hemorrhagic Cysts of the Kidney. *Br. Jour. of Surg.*, 1926, vol. xiii, p. 649.
- ³⁵ Brockenheimer: *Bel. Klin. Wehnschr.*, 1911, vol. xlviii, p. 1345.

NOTE.—Since this manuscript went to press six cases have appeared in the literature: Smith, L. D.: *Ill. Med. Jour.*, 1927, vol. lii, p. 291. Thomas, B. A.: *Trans. of Philadelphia Urological Society. Jour. of Urol.*, 1927, vol. xviii, p. 528, and Löffler, L.: *Ztschr. f. Urol. Chir.*, 1927, vol. xx, p. 407.

POSTERIOR EXCISION OF THE SEMINAL VESICLES*

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THE anatomic relations of the seminal vesicles and their relative inaccessibility have greatly augmented the difficulty of surgical extirpation under all conditions. The variety of surgical procedures that have been advocated is in itself evidence that no one method has been applicable to all cases under conditions of actual disease in the vesicles when the indications for extirpation were clear. Such indications have in the past been far from

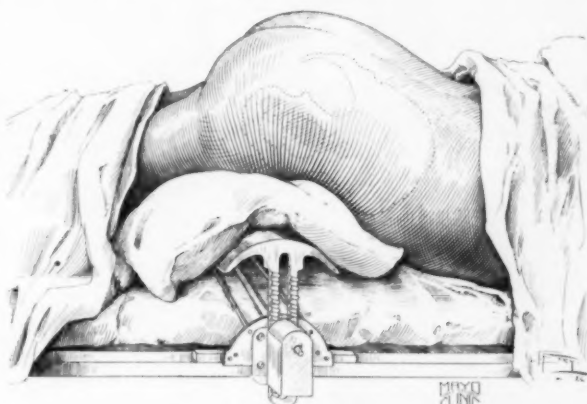


FIG. 1.—The prone position on the table with elevation of the pelvis tends to elevate the pelvic structures, including the seminal vesicles, into the operative field from a relatively deep position.

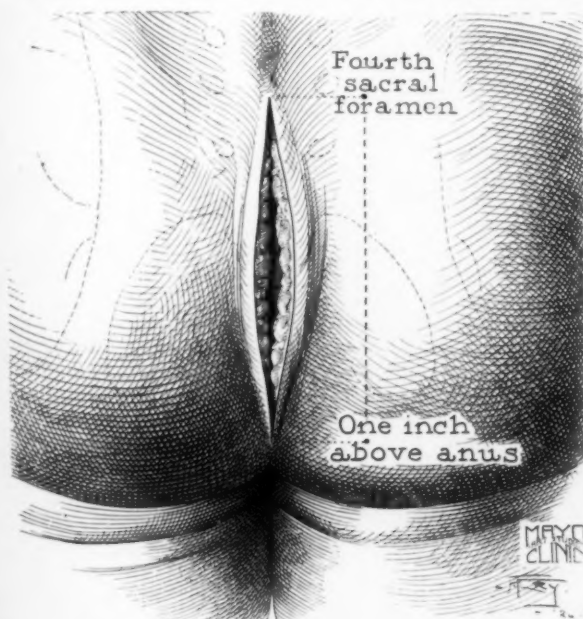


FIG. 2.—The incision in the median line extends from about 2.5 cm. above the anus to just above the sacrococcygeal articulation.

clear. A cursory review of the literature reveals numerous conditions for which the operation has been performed, chiefly urinary infection, impotency, nervous and mental disturbances and rheumatic conditions. It is obvious that the indications have been unrestricted. An unbiased analysis of the results of extirpation of the seminal vesicles narrows its applicability to a very small group of unquestionable pathologic conditions in the vesicles, not amenable to non-

* Read before the North Central Branch of the American Urological Association, Madison, Wisconsin, October 14, 1927.

operative treatment. In the consideration of the question of extirpation of the vesicles in the individual case, the basis of the decision should rest on the pathologic condition rather than on the uncertain hope of improvement

in sexual power, relief of mental disturbances, and benefit in rheumatic conditions.

The perineal route has been favored for extirpation of the vesicles and has provided a ready method for its accomplishment when the tissues are pliable and there is no gross change in the vesicles or perivesicular inflammatory reaction. However, in the presence of perivesicular disease, the vesicles are often

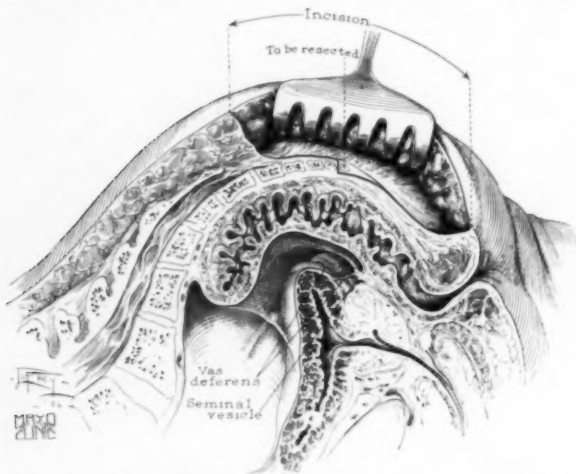


FIG. 3.—Sagittal section showing the accessibility of the vesicles by lateral retraction of the rectum after mobilization of the upper portion of the rectum and sigmoid.

densely adherent and at best may only be drained or incompletely removed. Fuller has reported a large series of cases in which extirpation was accomplished by a formidable operation in which, by a deep transverse perineal and two long lateral incisions, one on each side of the anus, the entire anus and rectum were elevated and displaced posteriorly to expose the prostate and seminal vesicles. The Rydygier incision likewise embraces a formidable procedure in the transverse division of the sacrum.

In the operation of posterior resection of the rectum for carcinoma, I have frequently noted the accessibility of the seminal vesicles through the posterior incision. A modification of this incision, avoiding displacement of the anus and obviating injury to the anal sphincters, seemed to afford a logical approach to the seminal vesicles. Furthermore, it seemed that the employment of the methods of mobilizing

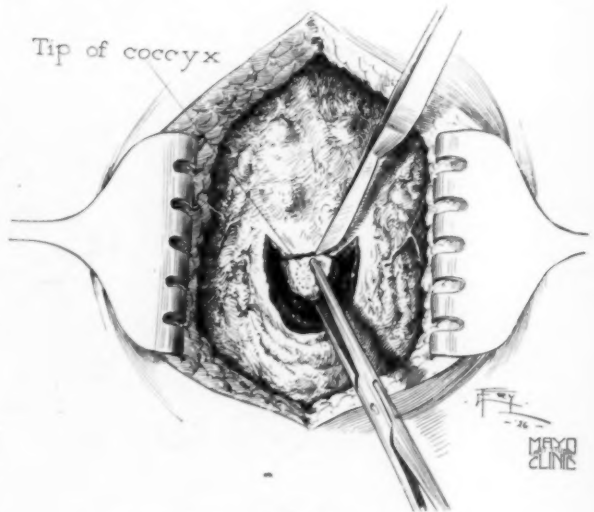


FIG. 4.—Knife excision of the tip of the coccyx.

POSTERIOR EXCISION OF THE SEMINAL VESICLES

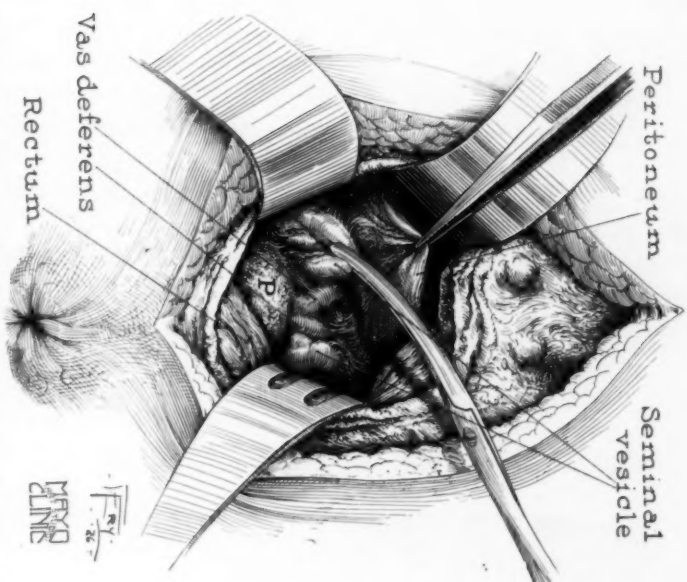


FIG. 5.—The reflection of the peritoneum covering the upper two-thirds of the vesicles is readily deflected upward.

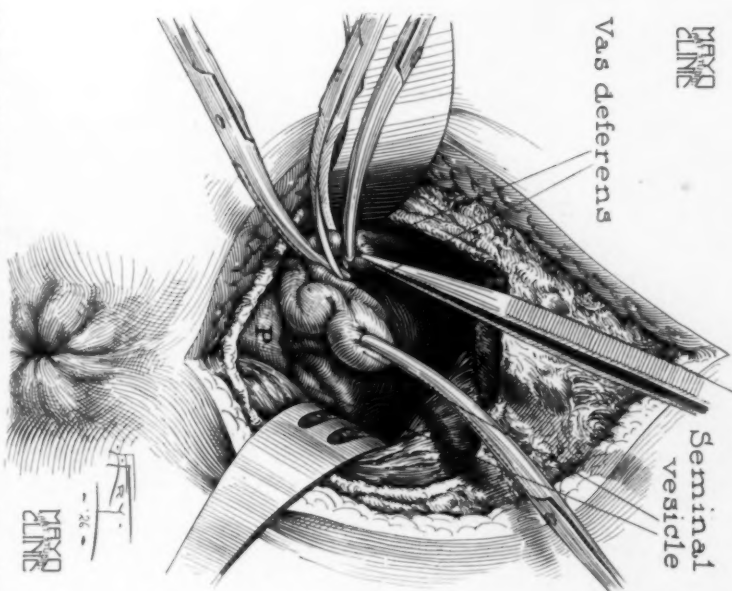


FIG. 6.—With upward deflection of the peritoneum the entire vesicle is exposed.

the upper portion of the rectum and sigmoid, as is the practice in posterior resection of the rectum for malignant disease, should afford adequate exposure of the seminal vesicles. The method has now been used in five cases in all of which the vesicles were densely adherent by virtue of extensive peri-vesicular inflammatory reaction.

The type of anæsthesia and the position of the patient are important factors in obtaining complete relaxation and adequate exposure through a

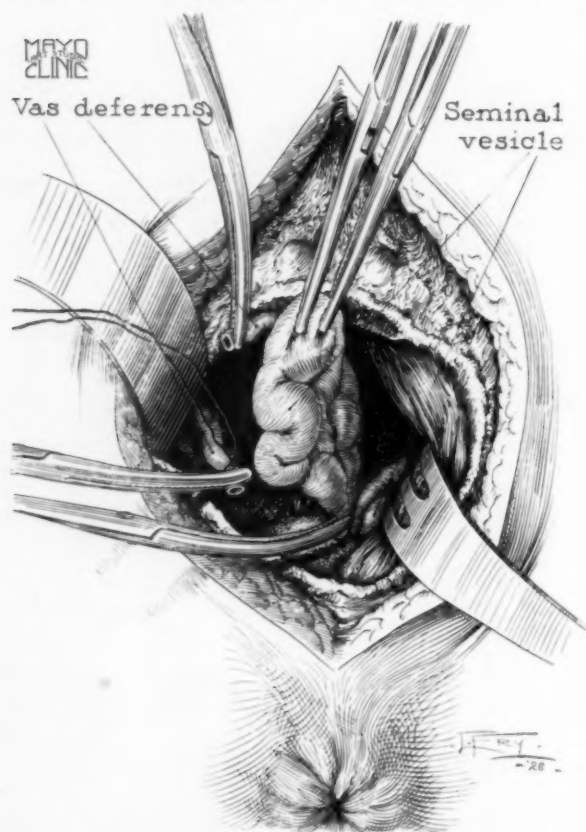


FIG. 7.—Complete extirpation of the vesicle with or without ligation of the vas.

relatively small incision. Complete relaxation is necessary and is best accomplished by the use of sacral anæsthesia, as described by Labat and Lundy. The prone position on the table with elevation of the pelvis (Fig. 1) tends to elevate the pelvic structures, including the seminal vesicles, into the operative field from a relatively deep position. The incision is made in the median line extending from about 2.5 cm. above the anus, or sufficiently far above the anus to avoid division of the anal sphincters, to just above the sacrococcygeal articulation (Figs. 2 and 3). The incision is carried down to the levators ani which are divided in the anococcygeal raphé. Lat-

eral retraction of these muscles immediately exposes the rectum supported more or less loosely by areolar tissue. Excision of the tip of the coccyx (Fig. 4) facilitates mobilization of the rectum and lower portion of the sigmoid by detaching them from the anterior surface of the coccyx and sacrum. I would emphasize the fact that detachment of the rectum and lower portion of the sigmoid from the anterior surface of the coccyx and sacrum obviates the necessity of excision of the entire coccyx or the higher transverse division of the sacrum, which has been advocated in the more formidable methods of posterior excision of the vesicles. The disarticulation of the tip of the coccyx with mobilization of the rectum facilitates lateral retraction of the rectum

POSTERIOR EXCISION OF THE SEMINAL VESICLES

and provides adequate exposure for extirpation of the seminal vesicles. The seminal vesicles, as they lie above the prostate, extend laterally and posteriorly around the anterior and lateral aspects of the rectum, which they in reality embrace, and are separated from the rectum in their lower third only by the retrovesical fascia. The reflection of the peritoneum covers the superior two-thirds of the vesicles (Fig. 5), and is readily deflected upward after division of the rectovesical fascia. Mobilization of the rectum and lower portion of the sigmoid and their lateral retraction immediately expose the vesicles after division of the rectovesical fascia; accurate visible dissection and complete extirpation of the vesicles are thus facilitated (Figs. 6 and 7). After removal of one vesicle the rectum is retracted to the opposite side and the other vesicle removed in a similar manner. Extirpation of the vesicles may be accomplished without ligation of the vas deferens; however, in the presence of marked inflammatory reaction division of the vas may be necessary. Troublesome hemorrhage has not occurred in any instance, and the moderate oozing sometimes encountered has been controlled by a light gauze pack left in place for several days. Inasmuch as marked perivesicular infection has always been present, it has seemed advisable to institute drainage in all cases (Fig. 8). In none of the cases has a sinus resulted. After extirpation of the vesicles the wound is closed by suturing levators ani together in median line. In all instances healing occurred without disturbance of function of levators or of anal sphincters.

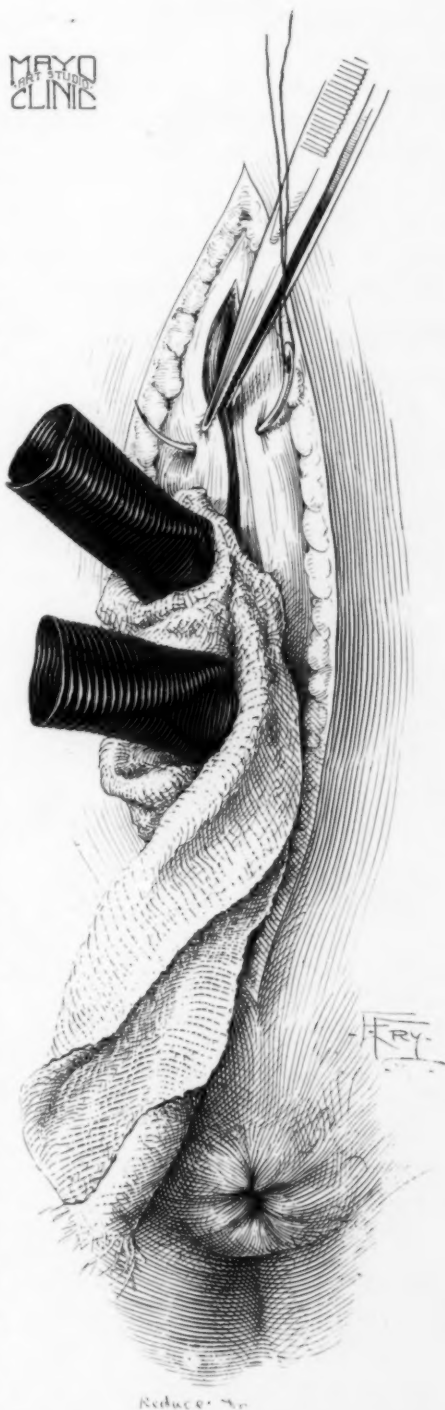


FIG. 8.—Rubber-tissue-and-gauze drain extending into the bed of the extirpated vesicle on each side.

In summary I would emphasize the restriction of the indications for seminal vesiculectomy to such cases of actual disease of the vesicles, not amenable to non-operative methods of treatment, as offer reasonable probability of benefit to the patient through the extirpation and removal of diseased structures. The indications on a functional basis are questionable. When the indications for seminal vesiculectomy are clear and based on definite pathologic changes in the vesicles, the method herein described is not formidable, obviates danger of injury to the anal sphincters, and facilitates visible extirpation of the vesicles.

MALIGNANT TUMORS OF THE TESTICLE

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FROM THE CLEVELAND CLINIC

Classification and Origin.—The origin and classification of malignant tumors of the testicle has been a subject of controversy ever since St. Donat²³ wrote on the subject in 1696. As the result of their investigations Langhans

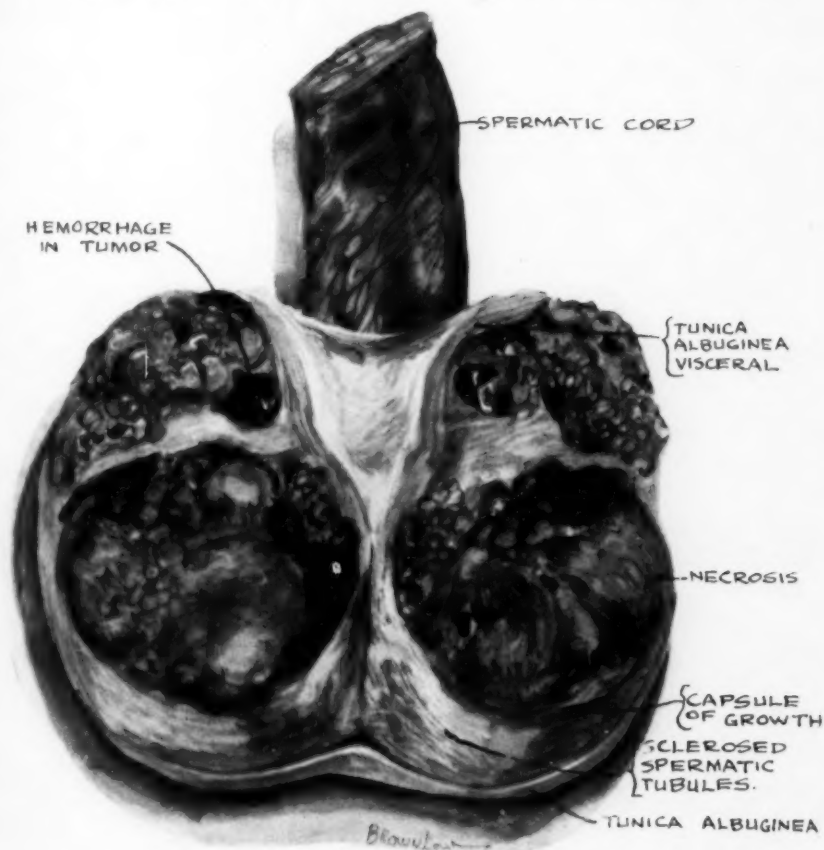


FIG. 1.—Specimen in a case of malignant tumor of the testicle. Pathological diagnosis—teratoma.

and Kocher,⁴⁷ in 1887, suggested a histological classification of testicular tumors; and concluded that the majority of these tumors are teratomatous in origin. This conclusion was disputed in 1906 by Chevassu,¹⁵ who stated that the majority of malignant tumors of the testicle were derived from spermatoblasts, and applied to them the term "seminome".

In 1911, Ewing³⁰ carefully reviewed the literature, and after studying

a series of cases, he also concluded that the majority of testicular tumors are of teratomatous origin.

Thus two theories regarding the origin of malignant testicular tumors have prevailed: (1) Kocher's theory that they are of teratomatous origin, which has been upheld by Ewing,³⁰ Ribbert,⁶⁴ Pick,⁶² Wilms,⁸⁰ O'Crowley and Martland,⁵⁷ and Cairns;¹⁴ and (2) the theory that they are deviations from spermatic tubules, which was advanced by Chevassu and has been supported by Eisendrath,²⁹ Geist and Thalhimer,³² Birch-Hirschfeld⁸ and others.

Ewing states that the spheroidal tumor, the origin of which has been so strongly contested, is produced by an overgrowth of one element in a pre-existing teratoma. He was unable to find evidence of its origin from the seminiferous tubules.

Eisendrath concludes that while the medullary tumors are primary tumors which arise from the seminiferous tubules, the other tumors of adenomatous character are teratomatous in origin, this being true even in cases in which the heterologous elements cannot be detected.

The term "embryonal carcinoma" has been applied to tumors which are classified as of teratomatous origin because of the presence of heterologous elements, or the occurrence of atypical tissue. (See Fig. 2.) Spermatocytomata are the solid, medullary tumors (of large cell type) derived from the seminiferous tubules.

The following classification by Schultz and Eisendrath⁶⁸ seems acceptable:

I. *Homologous Tumors.*

A. Benign:

(1) Epithelial:

(a) Adenoma of the seminal tubules.

(2) Mesoblastic:

(a) Fibroma (arising in the tunics).

(b) Leiomyoma (arising in the epididymis).

(c) Vascular tumors.

(d) Interstitial cell tumors.

B. Malignant:

(1) Epithelial:

(a) Spermatocytoma.

(2) Mesoblastic:

(a) Sarcoma.

II. *Heterologous Tumors.*

A. Benign:

(1) Cystic dermoid.

B. Malignant:

(1) Embryonal carcinoma.

(2) Sarcomatous mixed tumor.

Pathology.—Most malignant tumors of the testicle may be classified in two groups: teratomata, or mixed tumors, and spheroidal cell tumors. As we now know, sarcomata of the testicle are quite rare.

Teratomata comprise over half the malignant tumors of the testicle. They are very malignant and are frequently rapid in growth. In many cases the

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microscopical diagnosis is made with relative ease, but occasionally the overgrowth of one type of tissue completely obscures the other elements.

Grossly, the tumors are whitish in color, with areas of necrosis and

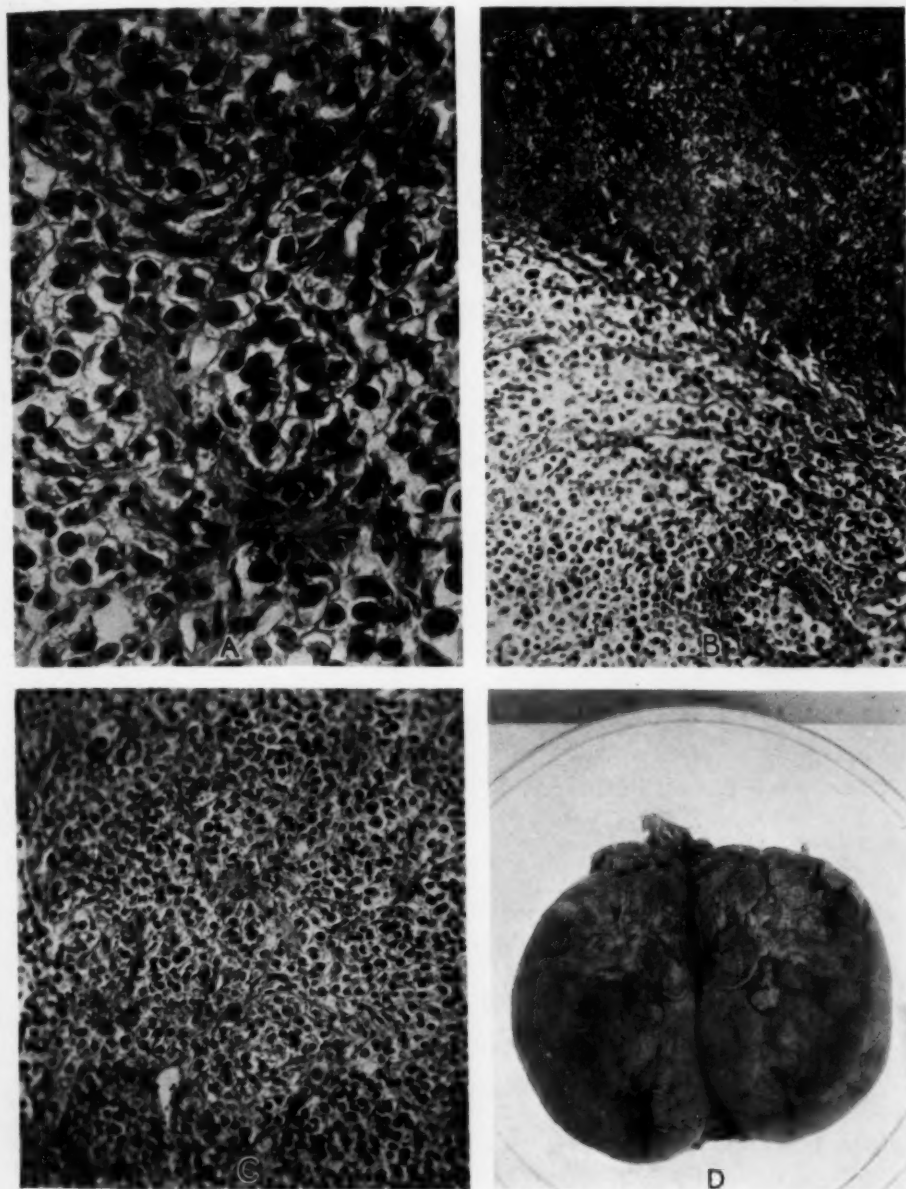


FIG. 2.—Photograph of specimen and photomicrographs of sections made in a case of malignant tumor of the testicle. Pathological diagnosis—embryoma. A—Photomicrograph X 200, showing technical embryonic type of cell with fairly abundant cytoplasm; B—X 100, showing area of necrosis; C—X 100.

hemorrhage. Cartilage and cysts may be present. Microscopically the various tissues are present in different stages of differentiation. The hetero-

logous elements are numerous and in many cases it is impossible to determine the specific germinal layer in which the cells have originated. Cartilage may be present in all the different stages of differentiation up to the point of ossification, and involuntary muscle fibres are also present in various stages of differentiation. Tissue of glandular structure also is usually present. Eisendrath mentions that atypical tissue may have the appearance of chorionic epithelium. Usually, however, the presence of heterologous elements indicates the teratomatous nature of the tumor.

The pathological picture of *spheroidal cell tumors* of the testicle is entirely different from that presented by the teratomata. These tumors are large, firm, and solid, yellowish in color, and medullary in character, and the microscopic appearance of the cells is quite characteristic. The tumors are very cellular with scanty reticulum. The cells are large and contain large vesicular nuclei and a granular cytoplasm. Degenerated areas may also be present, producing small white zones scattered through the tissue. The polyhedral cells are quite characteristic.

In Tanner's¹⁸ report of 97 malignant growths of the testicle, 35 were of the mixed type and 62 of the medullary type. Miyata,²⁵ in 1913, reported 27 cases of tumor of the testicle, 21 of which were classified as sarcomata, one as a sarcoma in a mixed tumor, one as a perithelioma and three as endotheliomata.

Bulkley¹² collected reports of 59 tumors in undescended testicles and found each to have been a sarcoma of some type except for 19 cases which were classified as follows: two teratomata, two epitheliomata, two chorio-epitheliomata, seven carcinomata, one rhabdomyoma, and five which were simply designated as cancer.

Butt and Arken,¹³ in 1914, described a case of bilateral sarcocarcinoma in undescended testicles.

Geist and Thalheimer,²² in reviewing the histopathology of 26 cases, found 20 cases of carcinoma, of which 16 were medullary and four adenomatous in type, and six cases in which teratoma was associated with carcinoma (adenomatous with medullary or papillary areas).

Eisendrath²⁰ has reported nine cases of embryonal carcinoma and six cases of spermatocytoma.

It is obvious that the great discrepancy in the incidence of various types of tumor is due in great part to varying methods of classification on the part of the reporters, some authors reporting large series of cases of sarcoma, the histological picture of which is identical with that of the large cell type of medullary tumor.

Of the 23 cases of malignant tumors of the testicle which I am reporting here, five were carcinomata, two sarcomata, five teratomata, and three embryomata, and in eight cases the type was not specified—in four of them no operation was performed.

Age Incidence.—The tumors appear most frequently during the age of greatest sexual activity, that is, between the ages of twenty and fifty; however, no age is exempt.

According to Kutzmann and Gibson,⁴¹ tumors of the testes are of comparatively rare occurrence in children. Steffen²³ and Gerhardt²⁴ state that when tumors of the testis occur in children, it is chiefly in early infancy, generally in the first six months

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or the first year. The incidence then gradually diminishes in the second, third and fourth years and the tumors seldom occur in later childhood. Kober⁴⁶ was unable to find any cases between the ages of ten and twelve years. Chevassu¹³ found five cases of teratoma in children in a series of 128 teratomata and seminomata.

Dean²⁴ states that the tumors occur usually before the fortieth year. Schultz and Eisendrath²⁸ described nine cases of embryonal carcinoma in which the average age of the patients was twenty-nine years, and six cases of spermatocytoma, in which the average age of the patients was forty-one years. These authors called attention to the fact that the age incidence of spermatocytoma was higher than that of embryonic

TABLE I.

Incidence of Tumors in Undescended Testicles in Relation to Total Series of Testicular Tumors.
(After Lipshutz)

Author	Testicular tumors	In undescended testicles			Percentage
		Ing.	Abd.	Total	
1. Howard.....	57	8	1	9	15.8
2. von Kahlden.....	41			5	12.2
3. Chevassu.....	128	10	5	15	11.7
4. Ufferduzzi.....	159			6	3.8
5. Hinman.....	32			7	21.9
6. Cunningham.....	67			0	0
7. Odiorne and Simmons...	54	2	4	6	11.1
8. Coley.....	64			12	18.7
9. Kober.....	114			18	15.8
10. Bulkley.....	9		2	2	22.2
11. Lower*.....	23	1		1	4.3

*This series.

carcinoma, but the clinical course was shorter and more rapid. Jefferson⁴³ states that the age incidence of tumors of the testicle lies between twenty and fifty years.

In our series of cases the youngest patient was twenty-one years of age and the oldest fifty-three, the average being thirty-four years.

Frequency and Location.—Cunningham²² found that in his series the incidence of new growths in testicles which occupied their normal position was 10.3 per cent. greater than in imperfectly descended testicles. In operations in forty cases of imperfectly descended testicles, Keyes⁴⁵ found no evidence of teratomata in any case. He has observed three tumors in testes in the abdomen.

Bulkley²³ states that among 12,729 male admissions to the Presbyterian Hospital in New York, thirteen cases of malignancy of the testicle were observed; and that of this series eleven were scrotal and two abdominal. The incidence of malignant tumors in abdominally retained testes was one in every seventy-five. Among all cases of malignancy in an abnormally located testicle, one in four occurred in the abdominal cavity, while the ratio of malignant growths in abdominal testicles to those in scrotal testes was one to fifteen.

Howard⁴² states that among 110,000 male admissions there were sixty-five cases

of testicular malignancy, and that fifty-six of these were scrotal and nine inguinal, there being no abdominal tumors in this series.

Eccles¹⁷ found thirty-eight testicular malignancies among 60,000 male admissions. In this series only one tumor occurred in an undescended testicle. Tanner¹⁸ states that one in every 2000 male admissions shows malignancy of the testicle.

In our series only one case (Case 22) occurred in an undescended testicle. (See Tables I and II.)

Reports in the literature vary as to the predominance of tumors in the right or left testicle, and many authors note no difference in the incidence

TABLE II.
Incidence of Testicular Tumors in Undescended Testicles.
(After Kutzmann and Gibson)

Author	Number of cases of undescended testicle	Number of testicular tumors	Percentage
Eccles.....	859	0	0
Coley.....	1357	0	0
Kocher.....	1000	1	0.1
Brenner.....	75	0	0
Hoffstatter.....	181	4	2.2
Goeritz.....	57	1	1.7
Total.....	3539	6	0.17

in this respect. In Cunningham's²² series thirty-four of the tumors were found to involve the right testicle, 25 the left, and three were bilateral. In our series, 14 tumors involved the right and 9 the left testicle.

Bilateral malignant tumors of the testicle are rare. Chevassu¹⁵ noted one case among 128; Kober,⁴⁰ five among 93 cases; and Cunningham,²² three among 67 cases. Councilman and Lovett²⁰ reported one case of bilateral teratoma of the testicles and Ochsner⁵⁶ also reported one such case. Our series of cases includes one bilateral case which will be reported in a later communication.

Etiology.—In many cases the patient gives a history of trauma, but this is frequently merely the incident that causes the patient to note an enlargement which is already present. In Cairn's¹⁴ series fourteen of the seventy-nine patients had observed the enlargement after a trauma of the testicle. Among the reports cited by Tanner,⁷⁵ in twenty-two of a series of 100 cases the patients gave a history of trauma. Pohle⁶³ states that trauma appeared to be an etiological factor in a few of his cases. Some reports give a history of trauma in 50 per cent. of the cases. Among the cases in our series, only four of the patients gave a history of trauma, and in two of these the accident had occurred many years before the development of the tumor.

In spite of the cases in which there has been a history of trauma, however, it is very doubtful whether trauma alone gives rise to the neoplastic

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process. We know that constant and prolonged irritation may promote the production of a malignant growth. The presence of a preëxisting tumor of the testicle cannot be excluded as a possible cause and such a tumor may be stimulated by trauma to more rapid growth. In the same manner constant pressure and irritation may exert a similar influence upon an undescended testicle lying in the inguinal canal.

Symptomatology and Diagnosis.—There are no pathognomonic signs or symptoms of a malignant tumor of the testicle. In fact, the diagnosis is occasionally reached by a process of exclusion. Pain and tenderness are present in many cases but are strikingly absent in others. In Tanner's⁷⁵ series, 52 per cent. of the patients complained of pain, while among Dean's²⁴ cases only a few patients made this complaint. In the latter series, 8 per cent. of the patients had abdominal pain, 29 per cent. had a lumbar ache, and 5 per cent. had abdominal cramps. In many cases the patients give a history of progressive enlargement of the testicle, with no pain until metastasis is present. Weakness and loss of appetite are also late manifestations.

In our series the subjective symptoms were testicular pain in four cases, or 17.4 per cent., more or less constant lumbar pain which was increased by movement in seven cases, or 30.4 per cent., loss of weight in six cases, or 26 per cent., and loss of appetite in three, or 13 per cent.

On reviewing the symptoms which were present in our cases when they were first examined, I found that before the primary operation, testicular pain had occurred in four cases, pain in the back in three, loss of weight in four, and loss of appetite in one case. As for the symptoms of the patients when they came to us at varying periods after operation—those in Group IV, pain in the back occurred in three cases and loss of weight in three.

(In making a differential diagnosis hydrocele, hæmatocele, gumma and tuberculosis must be considered.

A careful investigation of the personal and familial histories of the patient is of value in eliminating *tuberculosis*. The first evidence of the presence of a pathological condition of the testicle which is due to tuberculosis occurs in the epididymis and thence extends along the vas, which becomes nodular, the testicle becoming involved later. If the lesion extends to the skin of the scrotum, persistent sinus formation follows. Rectal examination of the seminal vesicles and prostate may demonstrate a tuberculous involvement. A röntgenogram of the lungs may also demonstrate the presence of an active tuberculous lesion. As for the clinical course of tuberculosis, it may be more rapid than that of a malignant growth, pain is more frequently present, and an elevation of temperature may be noted.

It must always be remembered that *hydrocele* and a malignant tumor of the testicle may coexist. This combination of diseases was found in two cases of this series. Transillumination should always be employed in making a diagnosis of hydrocele. The testicle should be carefully examined during operation to determine whether or not hydrocele is present; or if a hydrocele

is tapped, the testicle should be carefully palpated after the tapping to determine the presence or absence of a tumor.

In eliminating *hæmatocele* it is important to learn whether or not there is a history of trauma. An *hæmatocele* is usually a uniform swelling, and when it is present it may not be possible to transilluminate the scrotum or to produce fluctuation. French observers emphasize particularly that when this

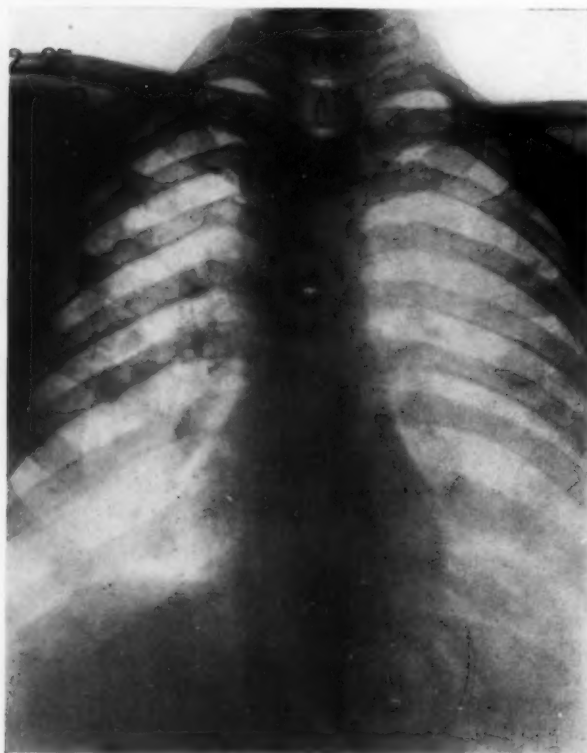


FIG. 3.—Röntgenogram showing evidence of metastasis in the mediastinum in a case of malignant tumor of the testicle. (Case XVI.)

condition is present the head of the epididymis cannot be palpated, but as it may also be involved by a tumor of the testicle or compressed by a large growth, this finding seems of little value from a diagnostic standpoint.

The diagnostic ability of the surgeon will be taxed to the utmost to differentiate an *hæmatocele* of long duration in which solidification and calcification have taken place from a malignant tumor of the testicle. Tanner⁷⁵ states that the tunica vaginalis can be palpated on the surface of a scrotal tumor and that this is not true in a case of *hæmatocele*, in

which also the epididymis cannot be felt between the fingers, as it is hidden within the *hæmatocele*.

In differentiation of a malignant tumor from a gumma careful questioning may elicit the history of the former presence of a primary luetic lesion. A Wassermann test is indicated in all cases of testicular tumor. If doubt as to the character of the tumor persists, then the administration of potassium iodid and of mercury may establish the diagnosis, as they will cause a gumma to decrease in size in from seven to ten days. It should be borne in mind, however, that syphilis and a malignant tumor of the testicle may coexist, so that undue dependence must not be placed upon a positive Wassermann reaction in a case in which the tumor does not respond to anti-syphilitic therapy.

In its early stages a malignant tumor of the testicle is firm and smooth

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and causes no change in the contour of the testicle, although nodulation may occur later. Palpation may produce pain or elicit tenderness, but this is not a constant finding. The epididymis is usually palpable and is clinically free from change. If necrosis has taken place in the tumor, fluctuation may be noted. The skin is usually uninvolved and moves freely over the testicle. The testicle cannot be transilluminated. Occasionally, on account of the need for an increased blood supply, the cord may be enlarged. An examination to determine the presence of glandular adenopathy in the left supraclavicular fossa and in the inguinal regions may be of value.

In differentiating malignant from benign tumors of the testicle, it should be remembered that the latter are quite rare in occurrence. However, the following benign tumors do occur: adenomata arising from the seminal tubules; fibromata arising from the tunica, leiomyomata arising from the epididymis, vascular tumors, interstitial cell tumors and dermoids. According to Cairns,¹⁴ only forty-

seven undoubted cases of dermoid of the testicle in man have been reported, 62 per cent. having been observed shortly after birth, and 84 per cent. in the first year of life. Only five of the forty-four were cases first observed after the patient had reached adult years. It is interesting to note that dermoid tumors associated with cryptorchism are occasionally found in the horse. (Hobday.)

The diagnosis of malignancy of an abdominal testicle cannot be made with certainty until a palpable mass is present. Changes in the breast and in the distribution of the hair have been cited, but these signs usually are absent. If pressure symptoms occur, such as lumbar pain, shooting pains down the legs, pressure on the rectum, and œdema of the legs, and the testicle



FIG. 4.—Röntgenogram showing evidence of metastasis in the mediastinum in a case of malignant tumor of the testicle. (Case XXII.)

TABLE III.
Data in Nine Cases of Malignant Tumor of the Testicle in Which Primary Treatment Was Given.

Case	Date of examination	Symptoms	Duration of symptoms	History of trauma	Size of tumor	Side	Clinical evidence of metastasis	Operation and date	Pathological diagnosis	X-ray therapy	Period between operation and last observation (in living cases)	Evidence of metastasis at last observation
1	11-9-20	Testicle eight times natural size, firm			45	L		Orchidectomy 11-9-20	Carcinoma		6 yrs. 8 mos.	None.
2	12-1-21	Testicle size of grape-fruit. No pain. Loss of 10 pounds during 4 months	4 mos.	20 yrs. before, caused slight enlargement	39	R		Orchidectomy 12-2-21	Undifferentiated malignant teratoma		1 yr. 9 mos.	
3	1-14-22	Very large testicle, growing rapidly. Very tender, sensation of heaviness. No pain. Hard and firm	2½ mos.		29	L		Orchidectomy and bilateral herniorrhaphy 1-20-22	Undifferentiated teratoma		5 yrs. 2 mos.	None.
4	3-6-25	Enlarged testicle. No pain. Superficial veins prominent	1 mo.		26	L	Epitrochlear, axillary and inguinal glands enlarged	Orchidectomy 3-16-25	Embryoma	Post-operative	2 yrs. 3 mos.	None.
5	9-21-25	Testicle size of goose egg, firm and hard	3 yrs.		38	R	Inguinal glands slightly enlarged	Orchidectomy 10-29-25	Embryonal carcinoma	Pre-operative	1 yr. 5 mos.	
6	12-3-25	Testicle size of goose egg, hard, smooth, tense; very little pain	3 mos.	3 mos.	43	R	Inguinal glands shotty	Orchidectomy 12-29-25	Teratoma	Post-operative For metastasis in abdomen February, 1927	1 yr. 5 mos.	Small mass below umbilicus not enlarging.
7	1-16-26	Constant, severe pain in right groin, hip and testicle. Testicle slightly enlarged, hard, tense, tender. Epididymis tender to pressure, with uneven masses size of pea	3 wks.		31	R		Orchidectomy 2-25-26	Teratoma		5 mos.	Large, hard tumor in upper right quadrant of abdomen.
8	4-6-27	Operation for hydrocele 20 years before. Testicle enlarged to size of grape-fruit following strain; tense and hard, lower portion fluctuant	1 yr.	1 yr. (strain)	53	L		Orchidectomy 4-7-27	Embryonal carcinoma			
9	4-14-27	Testicle size of goose egg, firm. No pain. Scrotum blue	2 mos.		27	R		Orchidectomy 6-1-27	Embryoma	Post-operative		

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is absent from the scrotum or inguinal canal, the possibility of malignant tumor in an undescended abdominal testicle should always be considered.

In cases in which a testicle located in the inguinal canal enlarges progressively, the possibility of malignancy should also be considered and surgery recommended.

Time Elapsing Before a Physician is Consulted.—In many cases, because of the slow development of the swelling and the absence of pain, the patients do not consult a physician until metastases are present. In our series the average length of time which elapsed between the discovery of the swelling of the testicle and consultation was ten months.

Clinical Evidence of Metastasis.—In many cases abdominal masses and evidence of inguinal adenopathy are present and also presumptive signs of metastasis such as lumbar pain, pain radiating down the leg, and oedema. Among the fourteen patients who came to us for primary examination and treatment eight showed no clinical evidence of metastasis. Among the other six cases there were metastases: in the abdomen, in one case; in the inguinal glands, in two cases; in the inguinal, axillary and epitrochlear glands, in one case; in the abdomen and supraclavicular glands in one case.

In the cases not included in the above list the patients had been operated upon or examined elsewhere previously, and came to us for X-ray therapy. Evidence of metastasis was present in each of these cases. Figs. 3 and 4 show röntgenological evidence of mediastinal metastases in two of the cases (Cases 16, 22) and Fig. 5 shows tumor masses in the supraclavicular region and in the lower abdomen.

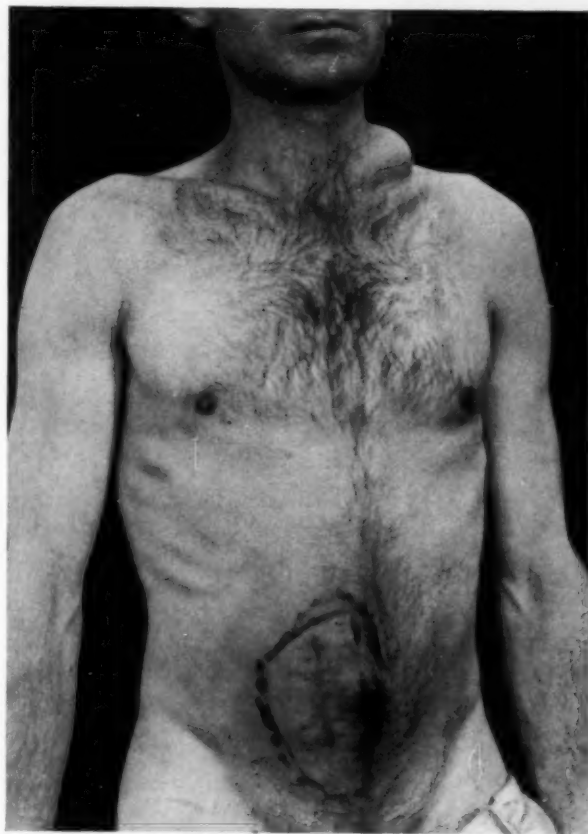


FIG. 5.—Photograph of patient with malignant tumor of the testicle. Note the tumors in the supraclavicular region and in the lower abdomen. (Case XXI.)

Mode of Extension and the Lymphatic System.—The lymphatic extension of the testicles is described by Leidy⁴⁹ and by Delamere, Poirier and Cuneo,²⁵ as follows:

"The lymphatics of the testicle are numerous and chiefly commence in the lymph-spaces in the intervals of the seminiferous tubules. From finer plexuses in the vascular tunic and epididymis a half dozen large trunks pursue the course of the spermatic veins and terminate in the lumbar lymphatic glands.

"The lymphatics of the testicle unite with the lymphatics of the epididymis, and the visceral layer of the tunica vaginalis, and run toward the lumbar region along the

TABLE IV.
Data in Two Cases in Which Operation was Advised But Refused.

Case	Date of examination	Symptoms	Duration of symptoms	Age	Side	Operation and date	Period between examination and death
10	6-5-22	Testicle enlarging progressively, size of orange, very hard. Enlargement along vas nearly to symphysis. No pain	3 mos.	34	R	Operation advised but refused	11 mos.
11	11-10-22	Pain in back and hip. Testicle enlarged, very firm, nodular		32	R	Operation advised but refused	5 mos.

spermatic cord. They are usually more superficial than the blood-vessels with which they are in immediate contact . . . In the lumbar region these trunks leave the spermatic vessels and run toward their terminal glands . . . The trunks coming from the right testicle terminate at the right juxta-aortic glands . . .

"The trunks of the left side end in the three or four glands of the left juxta-aortic group, which are arranged in rows below the renal vessels, but here again, we may sometimes see that some lymphatics are not arrested in the glands of this group, but directly reach the pre-aortic glands." (Delamere, *et al.*)

"The spermatic artery, a long, narrow vessel, springs from the aorta below the renal artery, descends along the psoas muscle, crosses the ureter and external iliac blood-vessels, and enters the internal abdominal ring, where it joins the spermatic cord and descends in advance of the deferent canal to the testicle. Approaching the latter it gives off a smaller branch to the epididymis, while the larger one divides into others which penetrate the albuginea along the back of the testicle and enter the mediastinum, whence they are distributed in the vascular tunic, partly on the inner surface of the albuginea and partly along the septula between the lobes of the testicle.

"A long thread-like vessel, the deferent artery, comes from one of the vesical arteries and runs upon the deferent canal its entire length, supplying it in its course and terminating by anastomosing with the branch of the spermatic artery distributed to the epididymis.

"The spermatic veins, passing from the vascular tunic of the testicle, emerge from the albuginea in a number of branches along the back of the testicle, where they are joined by others from the epididymis. The veins ascend in company with the spermatic artery in the fore part of the cord and anastomose with one another, forming a plexus. From this, two or three veins enter the abdomen and unite in a single trunk, which follows the course of the spermatic artery; that of the right side terminating in the inferior cava and that of the left side in the corresponding vein." (Leidy.)

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Treatment.—Many types of treatment for malignant growths of the testicle have been attempted: orchidectomy followed by X-ray, by radium packs, and by Coley's serum; orchidectomy followed by a radical resection of the gland; X-ray alone; and radium alone.

Coley's Serum.—Coley³⁸ states that the serum which he uses in the treatment of these tumors has an inhibitory action on the growth of the tumor cells. In some cases the action is sufficiently striking to prevent further development of the tumor, in other cases the growth may be held in check for a long period of time, while in some cases recurrences disappear following the administration of the toxin but usually reappear later.

Coley recommends orchidectomy as the primary treatment, this being followed by diligent and persevering administration of the toxin. The application of massive doses of radium to the abdomen and to the supraclavicular region is also advocated. The toxin is administered in the following manner: The injections are given deep into the buttocks, starting with a dose of one-half minim, and increasing daily by one-half minim until a mild reaction occurs, the temperature ranging from 100° to 102°. The toxin is then given three times weekly, the dosage being again increased until a mild reaction occurs. At the end of three months the injections are given twice a week. The treatment with X-ray and radium is repeated in from four to six months.

Pohle³⁹ also advises radiation with the Röntgen-ray or with radium. He states, however, that a favorable influence may be exerted by radiation, but a cure seldom results.

Dean³⁴ recommends, first, the application of low voltage X-ray to the testes, and of high voltage to the pelvis and lumbar nodes on the same side as the testicular lesion, followed, after three weeks, by an orchidectomy. He does not advise the radical removal of the glands. Two months after the first irradiation a radiation of the same intensity is again applied over the same areas and the patient is told to report at intervals for observation.

French authors advocate radiotherapy on the ground that seminomes are derived from spermatoblasts. Levin⁵⁰ also states that the specific action of radium on testicular cells accounts for its effect on malignant tumors of the testicle, the action of the rays being confined to destruction of the spermatogenic elements; however, injury of the other tissues is not evident.

As a result of their investigations, Barringer and Dean³¹ concluded that the embryonal type of tumor which they classify according to Ewing,⁵⁰ reacts best to treatment. This is opposed to the opinion of French observers as, according to Ewing, the seminome belongs in the same class as the teratoma of embryonic type (embryonal carcinoma).

Jefferson⁴⁹ recommends orchidectomy with high excision of the cord.

In 1882, Kocher⁴⁷ attempted the transperitoneal resection of the lumbar glands and this operation was repeated by Bland-Sutton⁹ in 1895 and later by Villar. Hinman⁵⁰ has collected seventy-nine cases, ten of his own series, in which radical operation was performed. Roberts, of Philadelphia, was the first to remove nodes which were uninvolved clinically (1901).

In determining the advisability of performing the radical operation for tumors of the testicle one point must be emphasized—the radical operation should not be attempted if the enlargement of the glands can be recognized clinically. X-ray therapy is preferable in these cases. When the glands are palpable they are enlarged to such an extent that their removal is impossible. According to Kutzmann and Gibson,⁴⁸ in only 50 per cent. of the cases are the glands removable after they become involved.

Another important point is that a microscopical report on the removed

testicle should always be submitted to the surgeon by the pathologist before the radical operation is performed. Cases have occurred in which the radical operation has been performed and a report of gumma of the testicle has later been announced by the pathologist.

In our Clinic we believe that X-ray treatment should be administered to the testicle prior to orchidectomy; and that following orchidectomy the X-ray should be systematically applied to the inguinal region, and to the lumbar and the left supraclavicular regions. Close observation and very frequent examinations are essential.



FIG. 6.—Drawing in illustration of the technical steps of radical resection of the primary lymph zone. a, Shows two types of incision. The one following the outer edge of the rectus for some distance and then curving out along the lower side of the twelfth rib gives a better exposure. b, Shows the initial inguinal incision exposing the cord which is clamped before delivering the tumor mass from the scrotum. c, Cautery division of the cord after gross inspection has confirmed the diagnosis. d, Shows the method of stripping back of the peritoneum beginning in the iliac fossa. The ureter and spermatic vessels strip up with the peritoneum. The vas deferens is seen crossing the ureter and is divided low down behind the bladder. (Reproduced through the courtesy of Dr. Frank Hinman.)

lateral, in which the spine is raised by placing a large kidney pad under the costal margin so that after the peritoneum is reflected, the abdominal vessels will be adequately exposed.

The skin incision extends from the inguinal canal and Poupart's ligament, curving upward in the anterior axillary line, at a point about three to four centimetres below the anterior-superior spine, and terminates at the costal margin. The incision is carried down to the peritoneum, which is reflected and pushed back, exposing the kidney and psoas muscle. The dissection of the

Technic of Radical Operation.—In our opinion the method of choice is a modification of Hinman's³⁹ operation. (Figs. 6 and 7.) Although the radical operation has not been employed in any of the cases included in this report, a description of the operative procedure should be included in this discussion. Adequate exposure is necessary for this extensive procedure. Perhaps the best position of the patient is the dorso-

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glands and lymphatics can then be carried on from above downward or from below upward. We prefer the latter method. The cord and vessels are stripped upward, toward the lumbar region. The glands and lymphatic-bearing tissue are carefully removed from the iliac fossa, care being taken to avoid injury to the ureter, which usually remains attached to the peritoneum and is reflected forward with it. The point at which the ureter crosses the iliac vessels is carefully exposed. Metastasis frequently occurs at this point, and also at the bifurcation of the aorta. The spermatic artery is clamped where it branches off from the aorta, and the spermatic vein, as it enters the renal vein or the inferior mesenteric vein.

The vas deferens is divided as it leaves the internal ring. The dissection is then carried upward along the anterior surface of the aorta, the lymphatic tissue being removed. Care must be taken to avoid injury to the inferior mesenteric artery. Since the spermatic vessels spread out above the point of ligation of the vas, the fascia is dissected to the lateral border of the psoas muscle. If the tumor involves the right testicle the vena cava

must be carefully stripped. The dissection is then carefully carried upward to the kidney. The fascia of the iliac and of the psoas muscle must be completely removed, as must also the inguinal glands on the side on which the tumor occurs.

Sharp dissection is the preferred method, as a more exacting and complete removal of the glands and lymphatics is secured in this way and less trauma is instituted. The operation is very extensive and is performed in a field in which vital structures are present. As the result of the division of the tenth, eleventh, and twelfth dorsal nerves, post-operative hernia may occur.



FIG. 7.—Drawing to show completion of the operation. The spermatic vessels at their point of junction with the abdominal vein and artery have been isolated, ligated, and divided before resection is attempted, which may then be carried out from above downward or from below upward. (Reproduced through the courtesy of Dr. Frank Hinman.)

TABLE V.
Data in Three Inoperable Cases.

Case	Date of examination	Symptoms	Duration of symptoms	Age	Side	Clinical evidence of metastasis	Operation and date	Pathological diagnosis	X-ray therapy	Period between examination and death	Period between examination and last observation (in living cases)	Evidence of metastasis at last observation
12	7-30-24	Testicle size of tennis ball, hard, firm. Not painful. Hard, nodular mass in left hypochondrium. Loss of 18 pounds. Fever, loss of appetite, pain in abdomen; constipation	3 yrs.	39	L	In abdomen at first examination. 9-9-25. In mediastinum 12-5-26. In spinal cord (VI D-segment)			7-31-24 9-9-25 1-1-26 1-23-26 5-16-27		3 yrs.	Yes.
13	5-14-25	Testicle swollen, hard, firm. Severe pain in lumbar region and abdomen	1 mo.	40	L	Masses in abdomen and supraclavicular area	Exploratory laparotomy; excision specimen	Teratoma	Pre-operative	4 mos.		
14	5-5-27	Testicle enlarged, smooth, fluid in scrotum. Slight pain radiating down legs	2 yrs.	39	L	Large fixed mass in abdomen			X-ray therapy advised			

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Prognosis.—Whatever type of treatment is employed, whether surgical or X-ray, the prognosis in cases of malignant tumor of the testicle is grave. Metastasis occurs early and may be present even when no clinical evidence of it is demonstrable and while the tumor of the testicle is still relatively small. When they are demonstrable clinically, the metastases are usually so extensive that a cure cannot be secured. However, by radium, X-ray, and Coley's serum, the course of the disease may be abated and a decrease in the size of the metastatic lesion may be secured.

According to Tanner,⁷⁵ the prognosis is influenced by the pathology of the tumor, mixed tumors being very malignant, carcinomatous tumors being malignant to a lesser degree, and dermoids being benign. Other observers agree with these conclusions, and our own results seem to confirm them, as in one of the cases of this series in which the tumor was a carcinoma, the patient is alive and free from metastases approximately six and one-half years after treatment.

Operative Mortality.—The operative mortality for orchidectomy is nil. The operative mortality for the radical operation varies from 10 to 20 per cent. This high mortality is explained by the fact that the patient frequently is not in good condition and the radical operation is very extensive.

Results of Treatment.—The results reported by various authors indicate that in cases of malignant tumor of the testicle the prognosis is grave. It is stated that 30 per cent. of the cases treated by radical operation are cured; while of the cases treated by orchidectomy only 15 per cent. are cured, these cases being the ones in which treatment is given early, before metastases have occurred.

In a review of seventy-nine cases—including ten personal cases—in which the radical operation was performed, Hinman³⁰ has reported that thirty-four of the patients were living and well, six of them over four years after treatment.

Barringer and Dean⁴ also have reported their results from the use of radium, which were not encouraging from a prognostic standpoint.

Codman¹⁶ has reported nine cases in which X-ray therapy was administered both before and after operation. In eight of them there were clinical evidences of metastasis when the X-ray treatment was instituted. Of these patients six had died and three were living, twenty-four, twenty-five and thirty months, respectively, after treatment.

In 1906, Cuneo²¹ performed the radical operation in one case and the patient was living and well three years later.

Kober⁴⁴ has reported ten cases in children, in four of which the patients died within one year after operation, while one patient was living two months after operation with a metastasis in the groin. In the other five cases no information as to the end-results was available.

Steffen⁷² has reported twenty-five cases, in thirteen of which the patients died from recurrence or metastasis within eleven months after operation. Of the seven who were living, three had recurrences, but two were living and well eleven months after operation; the condition of the other two living patients was not stated.

Chevassu¹⁵ has reported that among five cases of teratoma in children, four were living and well five months, two years and six months, two years and seven months, three years and eight months, respectively, after operation; the fifth case was not traced.

In a series of forty-four cases collected from the literature by Hinman, 41 per cent. died of cancer; all except two within one year after operation. Of these forty-four

TABLE VI.
Data In Nine Cases In Which Orchidectomy Had Been Performed Before Our Examination.

Case	Date of our examination	Symptoms at time of our examination	Duration of symptoms	Symptoms at time of operation	Duration of symptoms	History of trauma	Age at time of operation	Side	Clinical evidence of metastasis at time of operation	Operation and date	Pathological diagnosis	X-ray therapy	Period between operation and death	Period between operation and last observation (in living cases)
15	8-25-22	Broken-down glands in left inguinal region; enlarged glands in right inguinal region. Marked oedema of left leg. Loss of 15 pounds		Swelling of testicle			31	L		Testicle incised in 1918, drained one year. Orchidectomy in 1919; cord removed, gland in left inguinal region removed	Sarcoma (clinical)	For metastasis	Date unknown	
16	9-2-25	Right and left inguinal glands enlarged; large gland in right groin; large mass in left side of abdomen. X-ray of chest revealed extensive metastases. Marked loss of weight. Severe pain in back and down right leg	6 mos.	Swelling of testicle			34	R		Orchidectomy—1921. Excision of gland in right groin, March, 1925	Carcinoma	No treatment advised	4 years after primary operation.	
17	6-11-23	Irregular, hard nodular growth along spermatic cord. Swelling size of hen's egg in groin, with ulcerating skin		Painful lump in testicle which grew rapidly for 2 months before operation. Loss of weight	1 yr.	In youth	32	L		Orchidectomy 3-15-23	Spindle cell sarcoma	Post-operative X-ray and radium. X-ray recommended for metastasis		

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18	7-9-24	Enlarged glands in right groin. Sinus from scar in scrotum discharging bloody pus. Right inguinal region slightly painful and swollen		23	R	Orchidectomy 11-10-23. Recurrence excised 6-12-24	Sarcoma (clinical)	Post-operative. Advised for metastasis	
19	3-30-25	Swelling size of grapefruit in abdomen below umbilicus, hard, firm, increasing in size. Pain in back, down legs, in upper portion of right thigh. Right leg badly swollen and oedematous	3 mos.	37	R	Orchidectomy March, 1924	Sarcoma	Post-operative. For metastasis	1 yr. 3 mos.
20	12-11-24	Pain and swelling in right inguinal region. Pain in right shoulder and elbow. Hard, enlarged, tender glands in right inguinal region	1 yr.	49	R	Orchidectomy September, 1924. Excision specimen of groin, 12-12-24	Embryonal carcinoma	No treatment advised	6 mos.
21	3-5-25	Large mass in lower abdomen. Nodule size of egg in left side of neck. Recurrence in scar. Severe pain in back. Marked loss of weight. Patient anemic and cachectic	2 yrs.	24	R	Orchidectomy 10-29-24	Teratoma (clinical)	Advised for metastasis	Date unknown
22	3-25-25	A few hard, shotty glands in groin 10-21-25 Metastasis in mediastinum 11-2-25 Multiple nodules		21	R	Orchidectomy 3-11-25	Embryoma	Post-operative. For metastasis	11 mos.
23	8-24-26	Intermittent swelling over area treated by X-ray		32	R	Orchidectomy November, 1925	Teratoma (clinical)	14 post-operative treatments. 12 treatments administered.	1 yr., 6 mos.

cases, in two the lumbar glands were palpable before operation, while enlarged glands were found at operation in over 50 per cent. of the total series. The longest period that any of these patients had remained free from recurrence was four years and ten months.

Hinman also traced twenty-four cases in a series of thirty-two and found twenty dead and four living.

Tanner²⁰ collected 600 cases from the literature, of which the post-operative course had been followed in 465. Of these, 377, or 81 per cent., were dead and twenty-five, or 5.5 per cent., were alive and well four years after operation.

In reporting the results of treatment with radium and X-ray in his series of sixty-three cases, Dean²¹ has divided the cases into various groups: Among the six cases which he designated as "primary operable", four of the patients were living and well for periods ranging from one year and one month to three years and nine months after treatment, one was dead, and one could not be traced. Among the ten cases in the "primary inoperable" group, two patients were living and well six months, and three years and one month, respectively, after the first irradiation. Among the eight patients who had died the average duration of life after treatment had been fifteen months. One case was called "recurrent operable", but irradiation was employed instead of operation and the patient was free from disease nine months later. Thirty-nine of the patients were classed as "recurrent inoperable", and of these eight had remained living and well for periods of from six months to seven years and seven months, twenty-four were known to be dead, and seven could not be traced. Seven patients were referred for irradiation as a prophylactic measure after removal of the tumor. Of these three were living and well more than two years after treatment, three had died from metastases, and one patient could not be traced.

In 1915, Coley²² reported fifty-two cases in which the patients had been treated by orchidectomy and serum. Of these only two showed involvement of the lumbar nodes at operation. Of the remaining fifty patients, eighteen had died, fourteen had not been traced, and eighteen were living—three, four years; three, three years; one, two years; and two, one year after orchidectomy. Of the eighteen who were living, nine had metastases.

Gross has reported twenty-six cases, in three of which the patients had remained well, two for two years, and one for fourteen years after treatment.

Hinman collected forty-six cases in which the radical operation had been performed. The combined mortality was eleven per cent. Of the twenty patients who were still living, one had lived for five years, one for four years, five for three years, two for two years, and eleven for one year.

Of the twenty-three cases in our series, in sixteen there was no evidence of metastasis before operation. The end results in these cases is as follows: Six patients are living and eight have died and two have not been traced. Of the six living patients, two were seen too recently for any report regarding them to be of value; three are living without metastasis, six years and eight months, five years and two months and one year and six months after operation; one is living with metastasis five months after operation. Of the eight patients in this group who have died, one lived for four years, two more than one year, one eleven months, and one six months after operation; the date of the death of one patient is unknown; two refused treatment, one dying eleven months and one five months later.

In seven cases in our total series clinical evidence of metastasis was presented. Of these, two patients are living without metastasis two years and three months, and one year and five months, respectively, after operation;

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two patients are living with metastases, one, one year and five months after operation, one—an inoperable case—three years after treatment; two have died, one—an inoperable case—four months after X-ray treatment; one at an unknown date after operation; one case was seen too recently to be included in this report.

SUMMARIES OF CASE REPORTS

GROUP I.—*Nine cases in which primary treatment was given.*

CASE I.—On November 9, 1920, a patient forty-five years of age, entered the hospital, complaining of an enlargement of the left testicle. The testicle was found to be about eight times the natural size and firm.

Treatment.—Orchidectomy.

Pathological Diagnosis.—Carcinoma.

The patient was last heard from on March 25, 1927, when he reported that his condition was good, and that there was no evidence of any metastasis.

CASE II.—On December 1, 1921, a patient thirty-nine years of age entered the Clinic, complaining of an enlarged right testicle. About twenty years before he had been kicked by a horse in the right testicle, which had been slightly enlarged ever since, but had not been painful. About four months before, the right testicle had again begun to enlarge, and at the time of the examination it was about the size of a grape fruit. The enlargement caused no pain but interfered with walking. There was no tenderness. The patient had lost ten pounds during the preceding four months.

Examination revealed a poorly nourished, emaciated man, with the right testis greatly enlarged. It was not tender to the touch and was freely movable in the scrotum. There was no evidence of metastasis. The Wassermann test was negative.

Treatment.—Orchidectomy. A slight hydrocele was discovered, as well as the tumor.

Pathological Diagnosis.—Undifferentiated malignant teratoma.

The patient remained well over a year, but died September 11, 1923.

CASE III.—On January 14, 1922, a patient twenty-nine years of age entered the Clinic, complaining of enlargement of the left testicle. Six years before, bilateral inguinal herniæ had developed and the patient had been wearing a truss. About two and a half months before, the patient had noticed a sensation of pricking in the left testicle and had discovered that it was greatly enlarged. According to his story, it had increased greatly in size "overnight". At first it was tender to pressure but later it grew hard and was no longer tender.

Examination showed the left testicle to be markedly enlarged, hard and firm, but not tender. The epididymis appeared to be normal. There was no involvement of the cord. The Wassermann test was negative. Laboratory examination gave normal findings.

Treatment.—Orchidectomy and bilateral herniorrhaphy.

Pathological Diagnosis.—Undifferentiated teratoma.

When the patient was last seen, on March 25, 1927, his condition was good and there was no evidence of metastasis.

CASE IV.—On March 6, 1925, a patient twenty-six years of age entered the Clinic, complaining of a swollen left testicle. About one month before he had noticed that the left testicle which had previously been smaller than the right, was enlarging quite rapidly. There was no pain and no history of trauma.

Examination showed the right testicle to be normal, the left testicle symmetrically enlarged, and the superficial veins pronounced. It could not be transilluminated. The testicle was not tender. There were no nodules and the swelling did not involve the cord. The epitrochlear, axillary, and inguinal glands were enlarged.

Treatment.—Orchidectomy and X-ray therapy.

Pathological Diagnosis.—Embryoma.

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When the patient was last seen, on June 10, 1927, his condition was excellent and there was no evidence of metastasis.

CASE V.—On September 21, 1925, a patient thirty-eight years of age entered the Clinic, complaining of an enlarged right testicle. This testicle had always been smaller than the left until three years before, but it had been gradually increasing in size since that time, especially recently.

Examination revealed a large right testicle, of the size of a goose egg. It could not be transilluminated. The testicle was firm and hard, especially at the upper pole. There were no nodules and no tenderness. The process did not extend up the cord. The inguinal glands were slightly enlarged.

Treatment.—X-ray therapy followed by orchidectomy.

Pathological Report.—Embryonal carcinoma. (See Fig. 2.)

When the patient was last seen, on March 25, 1927, his condition was good.

CASE VI.—On December 3, 1925, a patient forty-three years of age entered the Clinic, complaining of an enlargement of the right testicle. Three months before he had injured the testicle and had had severe pain. It had been treated with hot compresses. Two weeks later he noted that the testicle was gradually enlarging, and by October it was as large as a goose egg. Since that time it had become quite hard but had caused very little pain.

Examination revealed the right testicle to be hard, smooth, tense and somewhat cystic and of the size of a goose egg. The inguinal glands were "shotty" in character. The Wassermann test was negative. Laboratory examination gave normal findings.

Treatment.—Orchidectomy, followed by X-ray therapy.

Pathological Diagnosis.—Teratoma.

The patient returned April 29, 1926, with a small, movable mass below the umbilicus. The X-ray treatments were repeated. On February 8, 1927, masses were still present in the abdomen and the inguinal glands were enlarged. X-ray therapy was again employed. When he was last seen, on May 21, 1927, the masses were still present, but were not enlarging and the patient's general condition remained good.

CASE VII.—On January 16, 1926, a patient thirty-one years of age entered the Clinic, complaining of severe pain in the right groin, hip and testicle, which had been present for the preceding three weeks. The pain was constant and was increased by movement. The right testicle had been swollen and tender for an indefinite period. The patient had lost fifteen pounds during the preceding two months.

Examination showed the right testicle to be slightly enlarged, hard, tense and tender. The epididymis was tender to pressure and in the globus major and minor were uneven masses of the size of a pea. No nodules along the vas, and no abdominal masses could be palpated. The Wassermann test was negative.

Treatment.—Orchidectomy. X-ray therapy was advised.

Pathological Diagnosis.—Teratoma.

On July 15, 1926, a letter was received from the patient's attending physician stating that in the right upper quadrant of the abdomen there was a tumor larger than a grape fruit in size, quite hard and not tender. The patient had lost some weight.

CASE VIII.—On April 6, 1927, a patient fifty-three years of age entered the Clinic, complaining of an enlargement of the left testicle. An operation for hydrocele of the left testicle had been performed twenty years before, and the patient had had no further trouble until a year previous to this examination. At that time, following a strain, the testicle had begun to enlarge until it had attained the size of a grape fruit.

Examination revealed the left side of the scrotum to be greatly distended, tense and hard, with the exception of the lower part, which was fluctuant.

Treatment.—Orchidectomy. X-ray therapy advised.

Pathological Diagnosis.—Embryonal carcinoma.

CASE IX.—On April 14, 1927, a patient twenty-seven years of age entered the

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Clinic, complaining of an enlarged testicle. About two months before the right testicle had begun to enlarge, and it was becoming firmer, though it was free from pain or tenderness. The physician whom the patient had consulted had told him that the enlargement was probably due to an injury or to gonorrhœa and had treated the testicle with poultices.

Examination revealed the right testicle to be of the size of a goose egg. The scrotum was not tender to the touch but it was blue in color on account of the collateral circulation. The epididymis was normal. There was no evidence of metastasis. The Wassermann test was negative. The laboratory examinations gave normal findings.

Treatment.—Orchidectomy, followed by X-ray therapy.

Pathological Diagnosis.—Embryoma.

GROUP II.—*Two cases in which operation was advised but refused.*

CASE X.—On June 5, 1922, a patient thirty-four years of age entered the Clinic, complaining of a painless enlargement of the right testicle which had been increasing progressively since it was first noticed three months before.

Examination showed the right testicle to be enlarged to the size of an orange and very hard. The enlargement extended along the vas nearly to the symphysis. There was no evidence of metastasis.

Operation was advised but refused.

The patient died on April 24, 1923.

CASE XI.—On November 10, 1922, a patient thirty-two years of age entered the Clinic, complaining of pain in the back and hip. The testicle was enlarged, very firm and nodular. A diagnosis of tumor of the right testicle was made and operation was advised, but the patient refused treatment. He died five months later.

GROUP III.—*Three inoperable cases. In one case X-ray therapy was employed, in the other two it was advised.*

CASE XII.—On July 30, 1924, a patient thirty-nine years of age entered the Clinic, complaining of loss of appetite, fever, pain in the abdomen and constipation. These symptoms had been present intermittently for about three years, during which he had lost eighteen pounds.

Examination revealed a tumor of the left testicle, hard and firm in consistency and of the size of a tennis ball. It was not tender. In the left hypochondrium there was a hard, nodular mass which was slightly movable.

X-ray therapy was instituted and the patient's condition improved greatly. On September 9, 1925, an X-ray examination revealed evidence of a metastasis in the mediastinum. X-ray therapy was again employed and a röntgenogram made July 1, 1926, showed a normal chest.

On December 5, 1926, the patient noticed that his legs were weak and he soon suffered from numbness below the waist and from loss of sphincteric control. It was thought that this was probably a metastasis in the sixth dorsal segment of the spinal cord and X-ray therapy was again instituted. The patient was last seen on May 16, 1927.

CASE XIII.—On May 14, 1925, a patient forty years of age entered the Clinic, complaining of severe pain across the back. He had felt perfectly well until the sudden onset of the pain one month before. The pain was increased by movement and relief was obtained by lying down. Three weeks before, abdominal pain had developed in both lower quadrants, there was no nausea or vomiting, but the pain was increased after meals.

Examination gave essentially negative findings except for lordosis of the spine with marked limitation of movement in all directions. The testicles showed no evidence of pathological change. The Wassermann test was negative. An X-ray examination of the dorsal spine and of the intestines gave negative findings.

On July 2, 1925, the patient returned, still complaining of severe lumbar pain. A

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large mass was present in the left supraclavicular region and the left testicle was considerably swollen, hard and firm. A large mass was also present in the lower abdomen.

After a course in X-ray therapy, an exploratory laparotomy was performed. Numerous large and small glands were found about the retroperitoneal space, and in the region of the eleventh and twelfth dorsal vertebræ, on the left side, there was a mass of the size of half an orange which was hard, somewhat irregular in contour, and apparently arose from the bone. One of the retroperitoneal glands was excised for diagnosis.

Pathological Diagnosis.—Teratoma.

The patient died on September 9, 1925.

CASE XIV.—On May 5, 1927, a patient thirty-nine years of age entered the Clinic, complaining of an enlargement of the left testicle which had first been noticed two years previously. Slight pain was present, which radiated down the legs. There had been no loss of weight. The testicle had been gradually increasing in size. About eight months before, the patient had noticed a mass in the abdomen, which had also increased in size.

Examination showed the left testicle to be enlarged, firm and smooth. Fluid was present in the scrotum. There was a large, fixed mass in the lower abdomen.

X-ray therapy was prescribed.

GROUP IV.—*Nine cases in which orchidectomy had been performed previous to our examination.*

In five cases X-ray treatment was administered, in two it was advised, in two cases no treatment was advised.

CASE XV.—On August 25, 1922, a patient thirty-five years of age entered the Clinic, complaining of œdema of the left leg. He stated that in 1918 the left testicle had become enlarged and tender and had been incised. It had drained for one year and then the testicle was removed. Later the cord became involved and was also removed, and a large gland in the left inguinal region was also removed later. The patient had lost fifteen pounds.

Examination showed broken-down glands in the left inguinal region, and enlarged glands in the right inguinal region. There was marked œdema of the left leg but there was no other evidence of metastasis.

Clinical Diagnosis.—Sarcoma.

Treatment.—X-ray therapy.

A letter addressed to the patient March 25, 1927, was returned, marked "deceased", but the date of his death is unknown.

CASE XVI.—On September 2, 1925, a patient thirty-eight years of age entered the Clinic, complaining of pain in the back and down the right leg. Four years before, the right testicle had become swollen and had been removed. He had remained well for three and a half years but a mass had then appeared in the right inguinal region. It was removed and a diagnosis of carcinoma had been made. Shortly after this operation the patient had begun to suffer from pain in the back, which was constant and so severe that morphin had to be administered. The patient had lost eighteen pounds during the month before we saw him.

Examination revealed an emaciated, pale individual who showed evidence of a marked loss in weight. The right and left inguinal glands were enlarged; there were enlarged glands in both supraclavicular regions; there was one large gland in the right groin, a large mass in the left side over the abdomen, and X-ray examination revealed extensive metastases in the chest. (Fig. 3.)

Pathological Diagnosis.—Carcinoma.

No treatment was advised.

The patient died on October 17, 1925.

CASE XVII.—On June 11, 1923, a patient thirty-two years of age entered the Clinic, complaining of a tumor in the groin and of a lump in the scrotum which had

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recurred following an orchidectomy. When the patient was a boy, his left testicle had been slightly injured. In March, 1923, he had consulted a physician concerning an enlargement of the left testicle which he had first noticed about fifteen months before. A small, hard nodule had appeared on the lower part of the testicle and the testicle had begun to enlarge rapidly and to become painful. The patient had lost considerable weight and was becoming pale. Orchidectomy was performed and a diagnosis of sarcoma was returned by the pathologist.

In April, the patient had noticed that a small lump was developing at the upper angle of the incision and a sinus had formed, which was discharging bloody serum. X-ray therapy was employed.

Examination revealed a well-developed and well-nourished man. Along the left spermatic cord there was an irregular, hard, nodular growth, and in the groin a swelling was noted, the size of a hen's egg, the skin over which was ulcerating.

Pathological Diagnosis.—Spindle-cell sarcoma.

More X-ray and radium therapy was advised.

CASE XVIII.—On July 9, 1924, a patient twenty-four years of age appeared at the Clinic to ask advice concerning post-operative treatment following orchidectomy for a malignant growth of the testicle. He had first noticed the swelling of the testicle in the spring of 1923. There had been no pain, the size alone calling his attention to the swelling. At one point the swelling had been very firm but had later become soft. A diagnosis of tuberculosis had been made and the testicle was removed. The pathological examination proved that it was a malignant growth and X-ray therapy was instituted.

After the operation the patient had noticed a lump at the end of the cord which had never disappeared and about two months before he came to the Clinic, a lump had also appeared in the incision and had begun to enlarge. Both lumps had been removed on June 12, 1924.

Examination revealed enlarged glands in the right groin; a sinus in a recent scar in the scrotum was discharging bloody pus, and the right inguinal region was slightly painful and swollen, but showed no distinct masses.

Clinical Diagnosis.—Sarcoma.

X-ray therapy was advised.

CASE XIX.—On March 30, 1925, a patient thirty-eight years of age entered the Clinic, complaining of pain in the right side of the back and extending down the legs, and of a tumor in the abdomen. A little over a year before, the patient had noticed a swelling of the testicle, which had been painful and tender. Orchidectomy had been performed and a diagnosis of sarcoma was made by the pathologist. X-ray therapy had been instituted. About six months after operation the swelling in the abdomen had appeared and this was associated with pain in the back and down the legs. The upper portion of the right thigh was also swollen. X-ray therapy was again employed.

Examination revealed a tumor the size of a grape fruit under the umbilicus. The tumor was fixed, slightly tender, and showed no fluctuation. The right leg was badly swollen and oedematous. X-ray examination revealed no other evidence of metastasis.

Pathological Diagnosis.—Sarcoma.

X-ray therapy was given.

The patient died June 8, 1925.

CASE XX.—On December 11, 1924, a patient forty-nine years of age entered the hospital, complaining of pain in the right inguinal region and in the right shoulder and joint. One year before the right testis, which had never descended, had gradually enlarged and had become quite painful. A hernia had also appeared. The testicle had been removed and the hernia repaired in September, 1924. Since the operation the patient had noticed the pain and swelling in the right inguinal region.

Examination revealed a well-healed scar in the right inguinal region and a line of

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hard, enlarged, tender glands, extending laterally from the symphysis from four to six centimetres. These glands seemed to be fused, but the overlying skin was free.

A biopsy was performed December 12, 1924.

Pathological Diagnosis.—Embryonal carcinoma.

The patient died March 6, 1925.

CASE XXI.—On March 5, 1925, a patient twenty-four years of age entered the Clinic, complaining of pain in the back and of tumors in the abdomen and in the left side of the neck. A right orchidectomy had been performed on October 29, 1924. The testicle had been enlarging painlessly for two years prior to this operation, and in the last four months before operation the patient had lost fifty pounds in weight. There had been a mass the size of a dime in the neck before operation and after the operation this had begun to enlarge. About three weeks after operation the patient had noticed that a mass was developing in the site of the incision and was enlarging quite rapidly. The pain in the back had begun in January and had become very severe; it was increased by movement.

Examination revealed an anæmic and cachectic patient who showed evidence of a marked loss in weight. There was a large nodule in the left supraclavicular region, of the size of an egg, and in the lower abdomen was a large mass, stony hard in consistency, fixed, and extending deep into the left lumbar region. (Fig. 5.) A mass was also present in the site of the incision.

Clinical Diagnosis.—Teratoma.

X-ray therapy was recommended.

A letter addressed to the patient on March 25, 1927, was returned marked "deceased".

CASE XXII.—On March 25, 1925, a patient twenty-one years of age came to the Clinic for post-operative treatment for tumor of the testicle. Two weeks before the right testicle had been removed and X-ray therapy employed. A pathological diagnosis of embryoma had been made.

Examination showed a few hard, shotty glands in the groin; otherwise there was no evidence of metastasis but an X-ray examination made on October 21, 1925, gave evidence of a destructive lesion in the upper anterior sternum, which was believed to be a metastasis. (Fig. 4.)

Pathological Diagnosis.—Embryoma.

Treatment.—X-ray therapy.

Four months later nodules developed in the skin over the body and the extremities. The patient died on February 18, 1926.

CASE XXIII.—On August 24, 1926, a patient thirty-three years of age entered the Clinic for X-ray therapy, following an orchidectomy for malignant tumor of the testicle. Operation had been performed in November, 1925, and 14 X-ray treatments had been given after operation.

Examination revealed no evidence of metastasis.

Clinical Diagnosis.—Teratoma.

Treatment.—X-ray therapy.

When last seen, on May 24, 1927, the patient's condition was good and there were no signs of metastasis.

BIBLIOGRAPHY

- ¹ Arousseau, M. L.: Tumeurs malignes du testicule en extopie abdominale. J. de chir., Paris, 1926, vol. xxvii, pp. 17-30.
- ² Bazy, P.: Teratome du testicule. Bull. et mem. Soc. de chir. de Par., 1919, vol. xiv, p. 952.
- ³ Barney, J. D.: Tumors of Testis Simulating Epididymitis. Jr. Am. Med. Assn., January 24, 1925, vol. lxxxiv, pp. 245-247.
- ⁴ Barringer, B. S., and Dean, A. L.: Radium Therapy of Teratoid Tumors of Testicle. Jr. Am. Med. Assn., October 15, 1921, vol. lxxvii, pp. 1237-1240.

MALIGNANT TUMORS OF THE TESTICLE

- ⁶ Bell, F. G.: Tumors of the Testicle (Spermatocytoma Group). *Brit. J. Surg.*, October, 1925, vol. xiii, pp. 282-301; (Teratoid group). *Loc. cit.*, July, 1925, vol. xiii, pp. 7-38.
- ⁷ Bécclère: La radiothérapie des néoplasmes intra-abdominaux d'origine testiculaire. *Bull. Acad. de med., Par.*, 1916, vol. lxxvi, pp. 72-81.
- ⁸ Beer, E.: Tumors of the Testicle. Chap. XVII, *Modern Urology*, Cabot, 1918.
- ⁹ Birch-Hirschfeld, F. V.: Zur Entwicklung des Hodenkrebses. *Arch. d. Heilk. Keipz.*, 1868, vol. ix, pp. 537-555.
- ¹⁰ Bland-Sutton, J. B.: An Improved Method of Removing the Testicle and Spermatoid Cord for Malignant Disease. *Lancet*, 1909, vol. ii, pp. 1406-1409.
- ¹¹ Bowing, H. H.: Radium and Röntgen-ray Treatment in Metastatic Testicular Tumors. *J. Radiol.*, December, 1922, vol. iii, pp. 519-521.
- ¹² Brickner, W. M.: Malignant Tumor of Testis; Orchidectomy; Coley's Fluid Injections; Cure; Case Report. *Am. J. Surg.*, 1923, vol. xxxvii, pp. 116-118.
- ¹³ Bulkley, K.: Malignant Disease of Testicle Retained Within Abdominal Cavity. *Surg., Gynec. and Obst.*, 1913, vol. xvii, pp. 703-719.
- ¹⁴ Butt, A. P., and Arken, A.: Malignant Disease of Retained Testicle, With Report of a Case. *Surg., Gynec. and Obst.*, 1914, vol. xix, pp. 419-420.
- ¹⁵ Cairns, H. W. B.: Neoplasms of Testicle. *Lancet*, April 24, 1926, vol. ccx, pp. 845-850.
- ¹⁶ Chevassu, M.: Tumeurs du testicule. Thesis, Paris, 1906.
- ¹⁷ Codman, E. A., and Sheldon, R. F.: Prognosis of Sarcoma of Testicle. Boston M. and S. J., February 19, 1914, vol. xvii, pp. 267-269.
- ¹⁸ Coley, W. B.: Cancer of the Testis, Containing a Report of Sixty-four Cases, With Special Reference to Twelve Cases of Cancer of the Undescended Testis. *ANNALS OF SURGERY*, July, 1925, vol. lxii, pp. 40-73.
- ¹⁹ End-results in Malignant Disease of the Testis. *ANNALS OF SURGERY*, 1923, vol. lxxviii, pp. 370-386.
- ²⁰ Cooper, Sir A. P.: Observations on the Structure and Diseases of the Testis. London, 1841.
- ²¹ Councilman, W. T., and Lovett, R. W.: Case of Double Teratoma. *J. Exp. Med.*, 1897, vol. ii, pp. 427-438.
- ²² Cuneo, B.: Note sur les lymphatiques du testicule. *Bull. et mém. Soc. anat. de Par.*, 1901, vol. lxxvi, pp. 105-110.
- ²³ Cunningham, J. H.: New Growths Developing in Undescended Testicles. *J. Urol.*, 1921, vol. v, pp. 471-479.
- ²⁴ de Saint-Donat: Observation d'une prétendue grossesse d'homme (inclusion scrotale). Rapport inedit de M. Dodart, lu a l'Academie des sciences le 20 novembre, 1697.
- ²⁵ Dean, A. L., Jr.: Treatment of Teratoid Tumors of Testis With Radium and the X-ray. *Jour. Urology*, 1925, vol. xiii, pp. 149-165.
- ²⁶ Delamere, G., Poirier, P., and Cuneo, B.: The Lymphatics. English edition by C. H. Leaf, London, 1913, p. 160.
- ²⁷ Descamps, P.: Sept cas de chirurgie du cancer testiculaire. *Bull. et mém. Soc. d. chir. de Par.*, 1920, vol. xlv, pp. 849-857.
- ²⁸ Eccles: *Lancet*, London, 1902, vol. i, pp. 569, 722. See Cunningham, *loc. cit.*
- ²⁹ Edington, G. H.: Sarcoma of Undescended (Abdominal) Testicle. *Brit. Med. Jour.*, March 25, 1922, vol. i, p. 475.
- ³⁰ Eisendrath, D. N., and Schultz, O. T.: Histogenesis of Malignant Tumors of Testicle. *Arch. Surg.*, 1921, vol. ii, p. 493.
- ³¹ Ewing, J.: Teratoma Testis and Its Derivatives. *Surg., Gynec. and Obst.*, 1911, vol. xii, pp. 230-261.
- ³² Frank, A.: Die histogenetische Ableitung der Hodentumoren. *Frankfurt Ztschr. f. Path.*, 1911, vol. ix, pp. 206-238.

- ²³ Geist, S. H., and Thalhimer, W.: Histopathology of Carcinoma of Testicle. *ANNALS OF SURGERY*, 1917, vol. lxvi, pp. 571-580.
- ²⁴ Gerhardt, C.: *Lehrbuch der Kinderkrankheiten*. Tübingen, 1878.
- ²⁵ Gold, E.: Inoperable Maligne Hodengeschwülste, durch Röntgenbestrahlung operabel geworden. *Mitt. a. d. Grenzged. d. Med. u. Chir.*, 1924, vol. xxxviii, pp. 102-113; *abs. Jr. Am. Med. Assn.*, Nov. 22, 1924, vol. lxxxiii, p. 1722.
- ²⁶ Grant, W. W.: Sarcoma of the Intra-abdominal Testis, With Report of a Case. *Jr. Am. Med. Assn.*, 1916, vol. lxvii, pp. 915-918.
- ²⁷ Handfield-Jones, R. M.: The Treatment of Malignant Disease of the Testicle. *Lancet*, 1924, vol. ii, pp. 850-852.
- ²⁸ Hepler, A. B.: Teratoma Testis, Radical Operation and Report of Two Cases. *North-west Med. J.*, October, 1925, vol. xxiv, pp. 499-505.
- ²⁹ Hinman, F.: Operative Treatment of Tumors of the Testicle; With Report of Thirty Cases Treated by Orchidectomy. *Jr. Am. Med. Assn.*, December 5, 1914, vol. lxiii, pp. 2009-2015.
- ³⁰ Hinman, F., Gibson, T. E., and Kutzmann, A. A.: Radical Operation for Teratoma of Testis, and Analysis of Seventy-nine Cases, Ten of Which Are Personal. *Surg., Gynec. and Obst.*, October, 1923, vol. xxxvii, p. 429-451.
- ³¹ Tumors of Testicle With Special Reference to Diagnosis and Treatment. *Calif. State Med.*, February, 1924, vol. xxii, pp. 48-51.
- ³² Malignant Tumors of Testicle, Pathological Study. *ANNALS OF SURGERY*, October, 1925, vol. lxxxii, pp. 552-575.
- ³³ Howard, R.: Malignant Disease of the Testis. *Practitioner*, London, 1907, vol. lxxxix, pp. 794-810.
- ³⁴ Jefferson, C. W.: Tumors of the Testes. *Am. J. Surg.*, May, 1923, vol. xxxvii, pp. 112-116.
- ³⁵ Johnson, G.: Case of Encephaloid Cancer Affecting a Testicle Which Had Been Retained Within the Cavity of the Abdomen. *Med. Chir. Tr.*, London, 1854.
- ³⁶ Keyes, E. L.: Malignant Tumors of Testicle; Diagnosis, Prognosis and Treatment. *Am. Jour. Roent.*, January, 1926, vol. xv, pp. 44-47.
- ³⁷ Kober, G. M.: Sarcoma of the Testicle; Conclusions Based on One Hundred and Fourteen Cases, 1899, vol. cxviii, pp. 535-553.
- ³⁸ Kocher, T.: *Die Krankheiten der männlichen Geschlechtsorgane*. Stuttgart, 1887.
- ³⁹ Kutzmann, A. A., and Gibson, T. E.: Malignant Tumors of Testicle in Children. *ANNALS OF SURGERY*, December, 1923, vol. lxxviii, pp. 761-784.
- ⁴⁰ Leidy, J.: *An Elementary Treatise on Human Anatomy*. Philadelphia, 1889, p. 650.
- ⁴¹ Levin, I.: Scope of Radium Therapy in Diseases of Genito-urinary Organs. *Urol. and Cutan. Rev.*, 1918, vol. xxii, pp. 6-9.
- ⁴² Lipshutz, B.: Malignancy of Undescended Testis Associated With Hydrocele. *ANNALS OF SURGERY*, August, 1922, vol. lxxvi, pp. 260-271.
- ⁴³ Lund, F. B.: New Growths in Undescended Testicles. *Bost. Med. and Surg. Jour.*, March 27, 1924, vol. cxc, pp. 553-536.
- ⁴⁴ Makius, G. H.: Multiple Fibromata of Tunica Vaginalis. *Proc. Roy. Soc. Med. Surg. Sec.*, 1911-1912, vol. v, pp. 155-158.
- ⁴⁵ Micholowsky, I.: Experimental Production of Teratoid Neoplasm of Testis in Chicken by Injection of Solution of Zinc Chloride Into Seminal Vesicles. *Centralbl. f. allg. Path. u. path. Anat.*, December 15, 1926, vol. xxxvii, pp. 585-587.
- ⁴⁶ Miyata, T.: Zur Kenntnis der Hodengeschwülste und die Bedeutung des Traumas für ihre Entstehung. *Arch. f. klin. Chir.*, 1913, vol. ci, pp. 426-448.
- ⁴⁷ Ochsner, A. J.: Tumor in Undescended Testicle. *Surg. Clin.*, 1917, vol. i, pp. 689-691.
- ⁴⁸ O'Crowley, C. R., and Martland, H. S.: New-growths of the Testis. *Surg., Gynec. and Obst.*, 1919, vol. xxviii, pp. 486-494.
- ⁴⁹ Odiorne, W. B., and Simmon, C. C.: Undescended Testicle; Based on a Study of Seventy-seven Cases. *Am. Surg.*, Phila., 1904, vol. xl, pp. 962-1004.

MALIGNANT TUMORS OF THE TESTICLE

- ⁸⁰ Petta: A Case of Teratoid Tumor of Testicle. Policlinico (sez Chir.), March, 1924, vol. xxx, pp. 134-146.
- ⁸¹ Peyron, A., and Corsy, F.: Sur la topographie et la signification des formations chorioplacentaires observées dans les embryomes du testicule. Compt. rend. Acad. d. sc., Par., 1924, vol. xvi, pp. 1263-1266.
- ⁸² Pfeiffer, G. E.: Malignancy of Testis, Report of Four Cases. Northwest Med., November, 1926, vol. xxv, pp. 578-582.
- ⁸³ Pick, L.: Zur Frage der Entstehung des Chorionepithelioms aus angeborener Anlage. Virchow's Arch. f. path. Anat., 1905, vol. clxxx, pp. 172-179. Über Neubildungen am Genitale bei Zwittern, etc. Arch. f. Gynak., 1905, vol. lxxvi, pp. 191-281.
- ⁸⁴ Pohle, E. A.: Teratoid Tumor of Testicle With Late Metastasis in Mediastinum, Report of a Case. Am. Jour. Roent., 1925, vol. xiv, pp. 5-7.
- ⁸⁵ Ribbert, H.: Geschwulstlehre für Ärzte und Studierende. Bonn, 1904.
- ⁸⁶ Roeder, C. A.: Lipoma of Testicle, With Consideration of Fat Attached to Inguinal and Scrotal Peritoneum. ANNALS OF SURGERY, February, 1927, vol. lxxxv, pp. 275-279.
- ⁸⁷ Scholl, A. J., Judd, E. S., Keyser, L. D., Foulds, G. S., Verbrugge, J., and Kutzmann, A. A.: Review of Urologic Surgery. Arch. Surg., December, 1926, vol. xiii, pp. 913-932.
- ⁸⁸ Schuldt, F. C.: Tumors of the Testis; Malignant and Inflammatory. Minn. Med., November, 1925, vol. viii, pp. 686-690.
- ⁸⁹ Schultz, O. T., and Eisendrath, D. N.: Histogenesis of Malignant Tumors of Testicle. Arch. Surg., 1921, vol. ii, pp. 494-520.
- ⁹⁰ Slye, M., Holmes, H. F., and Well, H. G.: Comparative Pathology of Testicle Tumors. J. Cancer Research, 1919, vol. iv, p. 53.
- ⁹¹ Smith, O. C.: Bilateral Sarcoma of Undescended Testes. Bost. M. and S. J., 1914, vol. clxx, pp. 839-840.
- ⁹² Southam, A. J., and Linell, E. A.: Pathology of Neoplasms of Testis. Brit. J. Surg., October, 1923, vol. xi, pp. 223-233.
- ⁹³ Steffen, A.: Die Malignen Geschwülste im Kindersalter. Stuttgart, 1905.
- ⁹⁴ Stoppato, U.: Über Zwischenzellent umoren des Hodens. Beitr. z. path. Anat., 1911, vol. I, pp. 113-142.
- ⁹⁵ Talavera, J.: Recherches histologiques sur quelques tumeurs du testicule. I. Tumeurs avec fibres musculaires striées; II. Carcinome épithélial; III. Épithéliome mucoïde et dermoïde; IV. Sarcôme angio-plastique; V. Lymphadénome, Paris, 1879.
- ⁹⁶ Tanner, C. O.: Tumors of the Testicle; With an Analysis of One Hundred Original Cases. Surg., Gynec. and Obst., November, 1922, vol. xxxv, pp. 565-573.
- ⁹⁷ Taylor, G.: The Aberrant Testicle; A Plea For Castration. Clin. J., London, 1918, vol. xlvii, pp. 26-28.
- ⁹⁸ Thompson, J. E.: Hypernephroma Arising in the Right Testicle. Jr. South. Surg. and Gyn. Assoc., 1911, vol. xxiii, pp. 408-418.
- ⁹⁹ Tizzoni, G.: Sarcoma midollare del testicolo. Riv. clin. di Bologna, 1876, vol. vi, pp. 145-156.
- ¹⁰⁰ Vecchi, A.: Teratoma, teratoide Geschwülste und Mischtumoren des Hodens. Deutsche Ztschr. f. Chir., 1912, vol. cxiv, pp. 104-162.
- ¹⁰¹ Wilms: Die teratoiden Geschwülste des Hodens. Beitr. z. path. Anat., 1896, vol. xix, p. 233, cited by Hinman, ref. 36.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held October 26, 1927

The President, DR. FRANK S. MATHEWS, in the Chair

PERFORATING DUODENAL ULCER—SECOND PORTION—SIMULATING DIVERTICULUM OF DUODENUM

DR. ALFRED STILLMAN presented a man, twenty-eight years of age, who had been well up to a month before his admission to Roosevelt Hospital in October, 1926, when he began to have pain and soreness in the epigastrium and indigestion. The pain was nearly continuous and worse after eating, radiating to the back. Bicarbonate of soda somewhat relieved him. He had sour eructations and vomited food but never any blood. He had lost some weight. Doctor Steiner, the röntgenologist, reporting on the X-ray gastric series, said the stomach and cap were shown without filling defect or deformity, but that there was a well-defined pouch apparently connecting with the descending arm of the duodenum. The stomach emptied at six hours, but the pouch was retentive and had all the characteristics of a duodenal diverticulum. At operation a large perforation, the size of a 25-cent piece, with thickened edges adherent to the gall-bladder, was found in the second portion of the duodenum. The perforation was closed by two layers of catgut stitches in the transverse axis and a posterior gastro-enterostomy made. The patient made a nice recovery.

TANNIC ACID TREATMENT OF BURNS

DR. FENWICK BEEKMAN presented four cases of burns of the body treated by tannic acid.

CASE I.—A boy, seven years of age, who was admitted to the wards of the Children's Surgical Service at Bellevue Hospital, July 1, 1926, suffering from second and third degree burns of the skin of the lower abdomen and groins, his clothing having caught fire from some burning gasoline.

It was estimated at the time that from 10-15 per cent. of his body surface was involved. The tannic acid treatment was immediately started. July 21 he was transfused with 400 c.c. of blood, and August 3, one day lacking five weeks, the burned surface was in such condition that it was grafted with one hundred full thickness pinch grafts from his thigh. Ninety-five per cent. of these grafts took. He was discharged from the hospital August 31, entirely healed. At no time during his treatment was his temperature over 102, and it came down to its normal level within a week after his admission.

In this case there was a child, severely burned, whose entire stay in the hospital until cured was less than two months, who never showed marked signs of toxæmia and who healed promptly when skin grafted. It may be noted, however, that he has a large keloid of the scar at this time, but no contraction resulting in interference in the function of his hip.

CASE II.—A girl, nine years of age, who was admitted to the Children's Surgical Service at Bellevue Hospital, January 16, 1927. Shortly

TANNIC ACID TREATMENT OF BURNS

before admission to the hospital her dress caught on fire from a candle resulting in a second and third degree burn of the skin over the anterior portion of the chest, abdomen, upper thighs and left wrist. In addition there was slight burning of the face, the eye lashes and eyebrows being entirely singed off. It was estimated that from 12-18 per cent. of the body surface was involved by this burn.

The tannic acid treatment was started immediately after admission. February 22, 1927, about five weeks following admission, the burned areas on her abdomen and thighs were covered with healthy granulation tissue in which there were multiple islands of epithelium. This area was strapped with strips of adhesive plaster.

March 12 she developed erysipelas at the edges of the wound on the abdomen. May 19, she was entirely healed and discharged home cured, just four months after being admitted. Her temperature at no time was above 102, excepting during her attack of erysipelas. The period in which her temperature was up lasted only about two weeks.

There is now a soft pliable scar. In this case there was a fairly large proportion of the abdomen involved, only a moderately severe toxæmia and a wound surface which healed rapidly without any operative procedure.

CASE III.—A girl, three years of age, who was admitted to the Children's Surgical Service at Bellevue Hospital, June 28, 1927. Just before admission her clothing caught fire and she was severely burned on her left arm from the axilla to the wrist and on the left side of her chest. This was a second degree burn. She was discharged home August 13, about six weeks after admission, entirely healed. Her temperature shortly after admission rose as high as 100.8°, but promptly dropped to normal by the end of the first week and did not rise again except during an attack of tonsillitis.

On removal of the tanned portion of the skin it was found that the wounds had entirely healed except in a few small areas. This child had a second degree burn covering a large surface. She had practically no toxæmia and healed rapidly under the tanned portion of the eschar.

CASE IV.—A boy, five years of age, was admitted to the Children's Surgical Service at Bellevue Hospital, August 1, 1927, and discharged nine days later. Shortly before admission a pot of boiling water had fallen from the stove, scalding him on the left side of the face and neck. The mother applied some form of grease. On admission there were many blebs on the face, neck and shoulder. Immediately upon admission the grease was removed with benzene and a 5 per cent. solution of tannic acid as a wet dressing was applied. Only about 50 per cent. of the burned area, however, became tanned because of the grease which had been previously applied. The healing took place rapidly and the patient never showed any signs of toxæmia. At present it is to be noted that the scars have almost entirely disappeared.

DOCTOR BEEKMAN said that he had never found tannic acid ointment for the face to be efficient and on consultation with the Ophthalmological Department at Bellevue Hospital he was told that a solution of tannic acid would do no harm to the eyes unless there was a corneal ulcer present. He had constantly been using tannic acid on the face, however, taking the precaution of keeping the eyes greased with boric ointment.

During the years 1924, 1925 and 1926, there had been admitted to the Wards of the Children's Surgical Service at Bellevue Hospital one hundred and thirty-four cases of burns. The tannic acid treatment had been first used in the fall of 1925. Ruling out the deaths which occurred in the first forty-eight hours after admission, the mortality had dropped from 10 per cent. to

3 per cent. since they had commenced to use this treatment. The average hospital stay for each case in 1924 was thirty-three days; that in 1926 while the tannic acid treatment was being used it had risen to forty-four days. This increase in the average length of treatment being explained by the fact that severe burns which would otherwise have died remained in the hospital for a longer period of time.

THE TANNIC TREATMENT OF BURNS

DR. ALBERT E. SELLENINGS read a paper with the above title.

DOCTOR MCCREERY said he thought that there was one point in the use of tannic acid which had not been emphasized in the cases that had been shown. Without doubt the tannic acid treatment was of very great value as a routine method of treating burns. Its value, however, depended to a very great extent on the time at which it was instituted and on the character of any first aid treatment that might have been used. Where any of the standard home remedies, such as carron oil or other forms of grease, had been used the tannic acid treatment was much less efficient even if strenuous measures were taken to remove the grease before the application of the acid. Furthermore, its use in late cases in which infection had developed was not only unsatisfactory but in his experience had done considerable harm by damming up the exudate under a firmly tanned wall. Leaving out these two classes of cases, however, he felt that the use of the tannic acid was a distinct advance and agreed in the estimates of its value in diminishing suffering and in shortening hospital and out-patient treatment.

DR. ROBERT T. MORRIS asked if it would not be possible to first control the infection and then apply the tannic acid. He had seen many cases two or three days after an extensive burn had been received and had treated them with immersion in various antiseptic baths. In two or three days the septic feature was disposed of and he then applied a covering of sterile animal membrane with scarlet red. Personally he had had no experience with tannic acid treatment and he wished to know if it could be administered after the infection had been brought under control, thereby adding what seemed to be a most important new treatment for burns.

DR. JOHN J. MOORHEAD considered tannic acid a method of chemical débridement. He considers that surgical débridement should be limited to third degree burns and others of a distinctly limited type under hospital control preferably where an immediate skin graft could be done.

There have been waves of enthusiasm for various kinds of treatment in burns as well as in other wounds, for essentially a burn is a wound due to heat. Now there is a wave of tannic acid popularity; not so long ago it was paraffin and Dakin's solution. All this indicates that there is no one best method in burn therapy. At certain stages the less done in the way of dressings and the more in the way of open air and electric exposure, the better for the patient.

THE TANNIC TREATMENT OF BURNS

There are three important indications in the treatment of burns—preventing shock, relieving pain and avoiding contractures.

DR. KIRBY DWIGHT emphasized the secondary rise of temperature in these cases of burns treated with tannic acid. A typical case would be as follows: A patient with an extensive third degree burn has been admitted to the hospital and tannic acid used. One is astonished to see that the patient does not suffer extreme toxæmia, considering the extent of the burn. The temperature on the second day is not much higher than on the first. The skin is tanned, the patient is without pain and one feels that the treatment of the burn, as far as the patient's life is concerned, is finished, and all one has to do is to wait for the damaged tissue to come away. Unfortunately that is not always the case. In a number of patients, after this satisfactory state of affairs has lasted from ten days to two weeks, there is for no apparent reason a gradual rise of temperature, one-half a degree a day, until the patient is in a dangerous condition again. What causes this secondary rise of temperature has not been determined. It is not the infection of staphylococcus or streptococcus that one sees in other wounds; there is no pus and the eschar is firmly adherent to the underlying tissue. Doctor Dwight said that his theory was that the deeper layers of this tanned tissue, in contact with the body fluids, might gradually be breaking down and protein toxins be getting into the blood. Whether this is the case or it is an infection, it is important that this tanned skin be removed before the toxæmia has continued too long.

DR. FREDERIC BANCROFT agreed with Doctor McCreery in that infection does occur beneath the tannic acid membrane. He said that prior to 1926 he had lost several cases treated with tannic acid because he had not removed the membrane and treated the underlying cellulitis. The case would go on for two or three weeks running a temperature of 102 or 103, not appearing very sick, and then would suddenly die. The speaker has always been impressed with the belief that the infection is anaërobic. There is a tanned membrane on one side and a scar tissue base on the other—an ideal area for anaërobic growth. The blood chemistry with the sodium chloride retention closely resembles that seen in gas bacillus infection. These patients clinically do not act as if they were toxic from destruction of tissue or infected by either the staphylococcus or streptococcus. Their clinical course resembles a sub-acute attack of gas bacillus infection. He is sure that during the last year several cases have been cured by treating the cellulitis which has developed beneath the tannic acid membrane by its removal and the treatment of the granulating infected area with a 1/5000 solution of acriflavine dressing. It is important in children, where there is a tendency toward contractures, to treat the epithelializing surface first and not the contractures. After epithelialization has occurred, contractures can be more readily dealt with. Moreover, if doctor and nurse each day while making rounds extend the limbs generally a great deal can be done to prevent the formation of contractures. He had used débridement for the introduction of the tannic acid

treatment and believes that he saved some cases by it that would have died otherwise; but does not think it compares to the tannic acid treatment now in use.

DR. FENWICK BEEKMAN stated that what impressed him in the tannic acid treatment of burns was the shortening of the period of healing. The treatment of burns can be divided into three periods: The immediate, the intermediate and the late. The immediate period is the time until the eschar separates. During this period we treat the individual to save life by preventing toxæmia and infection. In this treatment the period is shortened and made less severe than in the past types. The intermediate period is that of healing and we pay the most attention to local condition. When the eschar separates, those cases uncontaminated before the tannic acid was applied, will have a clean granulating surface and can be grafted sooner than formerly when burns were treated by the older methods. In this period by promoting healing we are preventing contractures. The faster the wound heals the less the scar tissue. The late period is the one in which contractures are corrected. The first two periods are shortened and there are less severe contractures if the burn is treated properly from the first. It is necessary to get the cases early; all the home treatments, greases, etc., interfere with the use of tannic acid and should not be used as first aid methods. Another important thing to do to get complete tanning, is to remove all loose epidermis as aseptically as possible. The eschar must never be punctured as this will introduce infection under it; it acts as a confining dressing.

DOCTOR SELLENINGS, closing the discussion, said that he appreciated that there was nothing new in his paper, but he had felt that the contribution of Davidson was so outstanding that it should be emphasized. He did not consider tannic acid treatment a fad; it is a distinct advance because it takes into consideration more definite pathology, limits toxæmia to a local area and has a logical basis. The literature gives a mortality as high as 50 per cent. from severe burns and under tannic acid treatment severe burns have a mortality of 20 to 25 per cent. As regards the use of tannic acid in burns that are seen late, it has been found that after the surface has been sterilized the tannic acid has the same effect upon epithelial growth as when applied in fresh burns. In a few cases tannic acid ointment has been applied to granulating wounds other than those following burns and the effect has been very striking. There is no doubt but that tannic acid stimulates epithelial growth.

Stated Meeting Held November 9, 1927

The President, DR. FRANK S. MATHEWS, in the Chair

GRAVES' DISEASE IN THE MALE

DR. EDWARD W. PETERSON presented a man, aged forty-two years, who was admitted to the Post-Graduate Hospital, May 27, 1927, on account of marked loss in weight with increasing nervousness and loss of strength. He had always been of a quiet, placid disposition previous to present illness. During the past six or seven months he noticed that he had become increas-

CONGENITAL GOITRE

ingly nervous, easily upset and excited, with palpitation of heart, tremor of hands and a quivering sensation in various parts of body and legs. When he leans over he becomes dizzy. There is dyspnoea on slight exertion. He has lost forty-two pounds in weight, with increased nervousness and muscular weakness. He appears thin and emaciated, weighing 108 pounds.

Physical examination showed a moderate exophthalmos, Von Graefe and Moebius' signs positive, thyroid very hard and only slightly enlarged. Bruit present. Heart regular, rapid, soft systolic murmur. Rate 100-130. Electrocardiographic study—negative, except for rate. Basal metabolism plus 48 (after entering hospital, plus 51).

Patient responded nicely to preliminary rest and iodine treatment, and after about one week operation was performed. A subcapsular bilateral resection of practically all of the thyroid was done June 3, 1927. Since operation there has been progressive improvement in the patient's condition. He has gained thirty-two pounds in weight. Tremor, nervousness and tachycardia have disappeared. He has been back at his work for several months.

The pathological report sustained the diagnosis of hyperplastic goitre in a stage of remission.

DOCTOR PETERSON then presented a man, fifty-three years of age, who was admitted to hospital, July 13, 1927, suffering from thyroid enlargement of six or seven months' duration, with nervousness, irritability and instability (eight months), voracious appetite and thirst, progressive loss of weight and strength (seven months) about twenty pounds, fine tremor of hands (nine months), exophthalmos, night sweats, palpitation of heart.

The man was thin and poorly developed, weighing 112 pounds, with wide staring exophthalmos, restless and nervous, perspiring profusely. The thyroid presented bilateral enlargement, bruit on auscultation; marked visible pulsation of neck. The heart's action was rapid, irregular as to rate, rhythm and intensity; blood-pressure 118/60; attacks of auricular fibrillation. Rate 120-160; fine tremor of hands; no oedema of feet and legs. The most important symptoms in this case were the rapid heart action, with attacks of auricular fibrillation, the extreme restlessness and the marked tissue dessication.

After about a week of rest in bed, with sedative treatment, the basal metabolism was plus 74. Lugol's solution was given in ten-drop doses, three times a day, and after nine days of its administration, on July 26, 1927, a bilateral subcapsular resection of the thyroid gland was performed. The patient stood the operation well and has made a most satisfactory recovery. He is back at work again, and in excellent condition so far as heart action and nervous system are concerned. There has been a gain of fifty-three pounds in weight.

The pathological report sustained the diagnosis of hyperplastic goitre of Basedow's disease.

CONGENITAL GOITRE

DR. EDWARD W. PETERSON presented a young man, now twenty-one years of age, who was first seen in July, 1916, when he was ten years of age, he being then sent to the Post-Graduate Hospital for treatment of a nodular irregular growth of the right lobe of the thyroid gland, which had been present since birth.

The family history was of interest. The mother had some enlargement of the thyroid gland. Two brothers died shortly after birth and both showed a swelling of the neck. An older brother had a similar swelling and had been operated upon in 1911, at the Lenox Hill Hospital. Later a swelling of the other thyroid lobe developed. This older brother showed definite evidences of cretinism.

The boy had measles when five years of age, otherwise he had always been well. He had an internal strabismus of the right eye. *Tonsils*—small, buried. The left testicle was undescended. He, too, showed marked evidence of hypothyroidism; viz.: backwardness in physical and mental growth, short, obese stature.

July 6, 1916, a right subcapsular lobectomy was done. At this time there was no evidence of trouble in the left thyroid lobe.

Pathologic report is as follows: *Microscopic*.—Portions of the gland still retain the general structure of the thyroid, but in other more or less circumscribed areas there is a very marked cellular hyperplasia and a distinct departure from normal. The thyroid arrangement is completely lost. The cells are grouped in irregular papillary masses with a loose fibrous stroma intervening. The cells stain deeply and are distinctly larger than normal. In general the growth appears to be proliferating in a distinctly atypical fashion, yet no mitotic dividing forms can be recognized. It is impossible to say whether the growth is now malignant, but it certainly presents characters suggestive of such tendency and in all probability if not completely removed would recur locally.

Following operation the patient was put on thyroid feeding. Improvement, both mental and physical, was rapid. After about a year, however, the family moved to another address and the patient was lost sight of, until May, 1927, when he again presented himself. He had been well until three weeks previously, when he noticed an enlargement of the left thyroid lobe, which had grown rapidly. In view of the malignant tendency in this case, operation was advised and was performed May 27, 1927.

The mass removed was a conglomeration of rounded adenomata, with small amounts of thyroid tissue intervening. The adenomata contained large cysts, some containing colloid and others filled with blood-tinged watery fluid.

Sections show a somewhat variegated structure. There are rather broad bands of oedematous fibrous tissue in which there are scattered thyroid alveoli variable in size and shape and lined by an epithelium in which the nuclei stain in an irregular fashion. There are also large cystic alveoli and in some places well-defined actively growing adenomata in which the epithelial cells are quite tall with occasional mitotic division figures in them. In these regions there is little or no colloid. The variation in growth activity permits one to recognize more deeply stained spots in the section with the naked eye, these spots representing more actively growing small adenomas.

The picture is somewhat difficult to interpret and especially difficult for prognosis. Actively growing lesions of this sort have a tendency to recur locally and even to give rise to distant metastases. However, the present example shows definite encapsulation of all the actively growing spots. The possibility of recurrence should, however, be kept in mind.

Practically the whole of the thyroid gland has been removed in this case. Thyroid extract seems to be called for here.

DOCTOR PETERSON also presented a young woman, age twenty-three, who was admitted to the Post-Graduate Hospital, January 18, 1905, when five weeks old, on account of a relatively large tumor on the right side of the neck.

There was some difficulty in breathing for the first two hours after birth, after which there was neither dyspnoea nor dysphagia. Aside from the deformity, the tumor apparently produced no symptoms. The growth was on the right side of the neck, behind and to the inner side of the sternomastoid muscle, extending from the level of the jaw downward nearly to the clavicle.

CHOLELITHIASIS AND LARGE UMBILICAL HERNIA

The tumor was made up of two masses, the larger situated above. It was smooth on the surface, of firm consistency, and did not fluctuate at any point. Below and to the side there was distinct palpable nodulation.

An incision was made parallel to the border of the right sternocleidomastoid muscle. A fibrous capsule which surrounded the growth was opened and the tumor was dissected out without difficulty. There was very little hemorrhage. Several times during the operation artificial respiration had to be resorted to. The wound was closed without drainage. For twenty-four hours after the operation the infant had to be prodded occasionally, as the breathing would stop. A nurse was in constant attendance and would do artificial respiration at such times.

The temperature rose to 105° F. shortly after the operation and then gradually declined. There were no special features until the ninth day, when there occurred a convulsion lasting for five minutes.

On the thirteenth day there was twitching of the extremities, and the eyes rolled from side to side. On the fourteenth day there were almost constant convulsive movements of the hands, arms, and legs, with twitching of the facial muscles and rolling of the eyes. It was about this time that the pathologist reported the specimen to be a "congenital thyroid tumor" (goitre). Believing from the appearance of the two lobes making up the growth, that the whole thyroid gland had been removed, thyroid extract was started at once, followed by a cessation of the tetany. At that time palpation of the neck revealed no evidence of any remaining thyroid tissue.

The thyroid feeding was kept up for the first four years of the patient's life, and was then discontinued.

At regular intervals since thyroid extract and iodine have been given, there have never been any evidences of cretinism. The development both mental and physical up to the age of puberty was perfectly normal. At this time a slight enlargement was noted on the left side of the neck, corresponding to the left lobe of the thyroid. There is now a small adenomatous enlargement of the left lobe which will require careful watching.

The original tumor removed was horseshoe in shape; one side composed of a large elongated tumor mass measuring 6 cm. in length, 4 cm. in width, 3 cm. in thickness. The other side is composed of a small tumor measuring 4 cm. in length, 2½ cm. in width, and 2 cm. at its greatest thickness. These two tumors are joined at the concavity of the horseshoe by an isthmus of fibrous tissue. Both of the tumor masses have a slightly irregular lobulated appearance.

Microscopic sections taken from both tumors showed the same structure which is that of the thyroid gland. The acini have undergone a slight adenomatous proliferation and are filled with a very dense colloid material, the greater number of them being very much distended by it to the dimensions of small cysts. The epithelium is very much flattened by intra-acinus pressure of the colloid. Nowhere does the epithelium show any malignant proliferation. The entire growth is surrounded by a thin, fibrous capsule.

CHOLELITHIASIS AND LARGE UMBILICAL HERNIA

DR. EDWARD W. PETERSON presented a woman, fifty-nine years of age, who admitted to treatment on account of an umbilical hernia, which was first noticed twenty-five years ago, and which has gradually grown until it has become extremely large. It is incarcerated and irreducible. She also complained of attacks of abdominal pain accompanied by nausea and vomiting, at times for the past ten years. The attacks of abdominal pain had become

much more frequent during the past two or three years. About three years ago there was jaundice, accompanying an attack, and it lasted for three weeks. The pain was in the right upper abdomen and radiated to the back, was accompanied by nausea and vomiting, and, of late, by chills, fever, and sweats and a loss of nearly fifty pounds in weight. She was emaciated and greatly weakened by her pain, sepsis and inability to take nourishment.

On May 26, 1927, under spinal anaesthesia, a long transverse elliptical incision was made, exposing the contents of the umbilical hernia. Incarcerated omentum and large, and small intestine with many adhesions, were found in the hernial sac. A large piece of omentum was resected and the intestinal adhesions were freed. It was possible through the hernia incision to expose the gall-bladder. It was quite small, its walls much thickened, and it contained several stones. A large stone was also found in the common duct.

A cholecystectomy and a choledochectomy, with removal of the common duct stone, were done. A stab wound was made through which a tube drain into the common duct and a cigarette drain to the gall-bladder bed were introduced. A Mayo closure of the umbilical hernia was done.

The patient made a slow but satisfactory convalescence and is now in excellent general condition.

DR. CHARLES L. GIBSON presented patients as follows:

GASTRO-ENTEROSTOMY FOLLOWING ADHESIONS AFTER CHOLECYSTECTOMY

A woman of forty-eight, who has had two previous operations by another surgeon, a cholecystoduodenostomy in 1924, and a cholecystectomy in 1925. She was admitted for the third time in February, 1927, on account of epigastric pain and vomiting—vomit contained blood. At this time a duodenal ulcer was found; an Ewald meal showed high acid content. Discharged to country as she refused operation. While in country she had severe epigastric pain and vomited blood on several occasions. Lost weight.

Admitted April 19, 1927, for operation. Examination showed a pale, undernourished, middle-aged woman with flabby abdomen and tenderness in mid-epigastrium. At operation diffuse adhesions were found over the entire right abdomen and the antrum and duodenum were quite compressed by these adhesions. No ulcer found. It was felt unwise to attempt to disturb the dense mass of adhesions which occupied the site of the previous operation, on account of the danger and difficulty of so doing and because it has been the operator's experience that a gastro-enterostomy gives complete relief in such conditions. This, therefore, was done. The patient made an excellent recovery. She was discharged home on the eleventh post-operative day with wound healed. Fluoroscopy six weeks later showed the stoma patent and functioning normally. Follow-up examination six months after operation showed an excellent result. Patient absolutely free from all symptoms.

CHOLECYSTENTEROSTOMY FOR CHRONIC PANCREATITIS

A young mother, age twenty-one years, was admitted to St. Luke's Hospital, July 24, 1902. History.—Seven months ago her child was born. One month later she had a sharp attack of pain in the right hypochondrium, shooting into the back. Such attacks have recurred about every week since, increasing in severity and followed in some instances by jaundice. She has lost weight and strength.

PERINEPHRITIC ABSCESS

On examination, a fairly well-nourished young woman. The skin and mucous membrane are of light yellowish hue. Abdomen.—Free border of liver thought to be one-half inch below free border of ribs. Provisional diagnosis. Cholelithiasis.

Operation, July 25, 1902. Incision parallel to free border of ribs. Gall-bladder not enlarged and contained no stones. No dilatation of nor stones felt in ducts. The pancreas was found to be somewhat hard and nodular and running across it were a number of dilated blood-vessels. Right kidney much more movable than normal. An anastomosis between the gall-bladder and upper jejunum was made with a Murphy button. Diagnosis: Interstitial pancreatitis.

DOCTOR GIBSON observed that he preferred using the upper jejunum rather than the stomach or duodenum for anastomosis of the gall-bladder. He believes that the objections to the use of the upper intestines are quite theoretical, as several late observations, including this one, fail to show any deleterious effects.

The post-operative course was uneventful. The patient passed the button on the seventh day. Discharged August 14, 1902.

In June, 1927, patient reports for another condition and states that she has never had any manifestations which might be referable to her pancreatitis. She has enjoyed excellent health, has borne several children, and has never had a suspicion of any gastro-intestinal disturbance. At the present time it is over twenty-five years since operation.

POLYA-MAYO EXCLUSION FOR DUODENAL ULCER

The patient was a man of thirty-one years, who was admitted complaining of pain in epigastrium of three months' duration. Physical examination showed a man in good physical condition, somewhat underweight, with some tenderness in the mid-epigastrium.

Fluoroscopic examination showed a post-pyloric ulcer of large size. At operation there was a large long ulcer just below the pylorus, extending down into the duodenum and did not seem resectable. Polya-Mayo exclusion was done.

Patient had a little heartburn following operation which gradually disappeared. Had no other symptoms at all and on discharge on the twelfth post-operative day had no symptoms.

Follow-up note October 20, 1927 (four months post-operative). Excellent condition and has gained in weight. Occasionally has some rather vague discomfort in the region of the wound.

This case is shown as a possible solution of the treatment of the severer form of duodenal ulcer which do not lend themselves to resection and where it is desirable to obtain greater guarantee of healing than may possibly be obtained by the usual gastro-enterostomy.

PERINEPHRITIC ABSCESS

A man of twenty-seven years was admitted complaining of pain in the left lumbar region, radiating to the testicle, which he had had about two weeks before admission. Had no chills and fever since the onset and there was no urinary disturbances. No history of infective focus obtained. Examination showed tenderness and sense of mass in left flank. The urine was negative and leucocytes were 13,800 with 87 per cent. polymorphonuclears. This rose later to 28,000. The temperature ranged from 100 to 103.8.

Under diagnosis of perinephritic abscess the usual kidney incision was

made and several ounces of pus evacuated from which was cultured the staphylococcus aureus.

The post-operative course was satisfactory. The wound rapidly cleared up under wet dressings and the patient was discharged on the thirteenth post-operative day with the wound nearly healed and in good general condition.

Follow-up note January 27, 1927. Excellent condition. No complaints.

About four days after operation a fair sized boil developed on the cheek which was incised. This is an interesting observation as in this case the suppurative focus was dormant.

DOCTOR GIBSON added that this patient was one of a series of twenty-five cases of perinephritic abscess which develops usually after some form of infection and gives practically always a culture of staphylococcus aureus. In the majority of cases a direct lesion of the kidney is not demonstrable, and urinary findings and manifestations are seldom present. The small number of women is in accordance with their usual immunity to boils and carbuncles.

In the literature some of these cases of perinephritic abscesses have been accompanied by a lesion described as a carbuncle of the kidney as first noted by Israel in 1901.

An interesting feature is the benign course of these cases, the constitutional manifestations subsiding at once with the establishment of drainage, healing is prompt and the subsequent recovery is that of perfect restoration to health.

Of these twenty-five cases, in addition to the perinephritic abscess, three of these cases also had a solitary abscess of the kidney. (a) Abscess in perinephritic fat which led down to an abscess in the lower pole of the kidney. (b) Abscess in posterior portion of the upper pole, and abscess formation in the retroperitoneal space. (This case also had a splenectomy for splenomegalia.) (c) Large perirenal abscess, also large opening on posterior surface of the kidney.

Twenty-three were males, two were females (92 per cent. males).

Ages.—One to ten, one case; ten to twenty, four cases; twenty to thirty, seven cases; thirty to forty, ten cases; forty to fifty, two cases; fifty to sixty, none; sixty to seventy, one case. (Sixty-eight per cent. between twenty and forty, 20 per cent. below twenty—12 per cent. over forty.)

Duration of Symptoms.—One to two weeks, fifteen cases; three to four weeks, seven cases; three months, one case; four years, one case; twenty years, one case.

Previous History of Infection.—1. Rheumatism lower extremities (six months previous). 2. Abscess of foot (three months previously). 3. Came in with carbuncle of neck (gives history of tendency to boils). 4. Frequent abscesses on many parts of body (subsequent readmission for osteomyelitis of femur and pelvis). 5. Two large boils on arm (three weeks previous). 6. Infected finger (two months previous). 7. Furuncle of neck (three weeks previous). 8. Developed perinephritic abscess in fifth week of typhoid fever. 9. Two boils on knee and one in submaxillary region (two months previous).

RESECTION OF SUPERIOR MAXILLA FOR OSTEOSARCOMA

(*Note.*—One case developed acute arthritis on her eleventh post-operative day. One case developed boil of face on his fourth post-operative day.

Transferred from Medical Side.—Thirteen cases (52 per cent.).

Highest Temperature Before Operation.—Ninety-eight, one case; 100 to 101, one; 101 to 102, one; 102 to 103, seven; 103 to 104, ten; 104 to 105, four; 105 to 106 one. Sixty-eight per cent. between 102 to 104, 20 per cent. over 104; 12 per cent. below 102.

Culture of Wound.—*Staphylococcus aureus*, 20; *staphylococcus aureus* and *albus*, 1; *bacillus proteus*, 2; *typhoid bacillus*, one; no report of culture, one.

Culture from Blood.—No blood culture, thirteen; blood culture sterile, eleven; blood culture positive, one; *staphylococcus albus*.

Stay in Hospital—post-operative.—Less than fourteen days, seven cases; fourteen to twenty-one days, eight cases; twenty-one to twenty-eight days, three cases; twenty-eight to thirty-five days, one case; thirty-five to forty-two days, two cases; fifty-three days (complicated by pleurisy with effusion); seventy-four days (complicated by typhoid fever); ninety days (multiple perinephritic abscesses—long convalescence); one case still in hospital.

Results.—Twenty-one excellent results; one case recovered from abscess; but patient when last heard from was very ill with his osteomyelitis. Two no trace of patient after discharge. One case still in hospital, nine days post-operative. Condition excellent.

RESECTION OF SUPERIOR MAXILLA FOR OSTEOSARCOMA WITH PRESERVATION OF HARD PALATE. WELL NINE YEARS AFTER OPERATION

DR. JOHN DOUGLAS presented a girl, twenty-three years of age, on whom he operated in 1918. She had noticed a growth in the right nostril, four months previously, which had greatly increased in size until the time of admission to the hospital. It was then about five by three centimetres in diameter and completely filled the right side of the nose, deflecting the septum to the left and completely filling the nasal cavity, protruding from the right nostril and projecting into the nasopharynx posteriorly. The Wassermann was negative.

August 13, the growth was separated from the nasal cavity, drawn out in pieces and the nasal cavity well cleaned; when it was found that the growth had taken origin in and projected from the antrum. A frozen section was made from this tumor which proved to be an osteosarcoma. No giant cells were present. Two days later a resection of the superior maxilla was performed in the typical manner, with the exception that, instead of making the usual median incision through the hard palate in the median line, the mucous membrane along the alveolar border of the jaw was divided and the mucous membrane and periosteum separated from the hard palate. An incision was then made through the bone in the median line and the superior maxilla removed in the ordinary way, the flap of periosteum and hard palate being then sutured to the divided edge of the mucous membrane of the cheek with the exception that at the posterior angle, where the hard and soft palate joined, an opening was left for drainage. Through this opening packing was inserted into the space left by the resection of the superior maxilla, thus leaving most of the roof of the mouth in place instead of

having the oral cavity continuous with that of the nasal as is usual after a resection of the superior maxilla. This was deemed safe in this case as the growth, while taking its origin from the antrum did not seem to involve the bone. Before doing the resection an incision was made in the neck and the glands excised and the external carotid artery ligated.

A further microscopical examination of the section removed showed tumor tissue of the same type as previously described, involving the antrum but not involving the bone, although distinct fragments of well-formed bone containing growing bone cells surrounded by a layer of osteoblasts was scattered through the tumor tissue. As before no giant cells were found.

The drainage opening has contracted and become smaller and patient now wears a plate with comfort, and the result is obviously better than if the large portion of the roof of the mouth had been removed, and while this may not be a safe procedure in a number of cases, as when the bone is involved in carcinoma, in this case the results justify the means employed.

OSTEOFIBROMA OF SUPERIOR MAXILLA

DOCTOR JOHN A. McCREERY presented a colored girl of eighteen years who was admitted to the First Surgical Division of Bellevue Hospital, in September,

FIG. 1.—Osteofibroma of superior maxilla. Removal with long standing freedom from recurrence. (McCreery.)

1927, complaining of swelling of left side of upper jaw. In 1919, a small tumor was removed from the upper jaw, apparently from within the mouth. It has been impossible to determine the nature of this growth. The tumor recurred and has grown slowly, the patient finally applying for relief because of the deformity and difficulty in swallowing.

On admission she presented a tremendous enlargement of the left side of the face (Fig. 1), apparently due to a tumor of the superior maxilla, which had gradually grown forward and downward so that the patient's face presented the appearance of a pig's snout. The mass was firm with areas of superficial ulceration. X-ray showed an apparently localized tumor measuring 12 cm. in diameter, involving the body of the superior maxilla, considered by röntgenologist to be an osteoma. A section of the growth was removed and was reported as a non-malignant mixofibroma.

With this diagnosis an attempt was made by Doctor Potter and Doctor Kaplan to remove the tumor with the endotherm knife. It was found, when cutting into the mass that the tumor was much more dense than had been

FIBROMA OF LOWER JAW

expected and contained large amounts of bony tissue. As much as possible of this was removed with a chisel, the endotherm being of great value in controlling bleeding, which was rather free.

DOCTOR McWHORTER reported that the tissue removed weighed 300 grams and appeared to be made up of dense connective tissue and bone. After decalcification section showed dense masses of interwoven connective tissue, scattered through which were masses of adult bone. The tumor was moderately vascular and was considered to be an osteofibroma.

Four weeks after the partial removal of the growth, the sloughing surface had in large part cleared up and mucous membrane was growing across the raw area. At this time Doctor Kaplan implanted 30 radium needles, with some difficulty because of the dense fibrous and bony character of the lesion. The implantation of these needles has been followed by a considerable amount of necrosis and sloughing in the remaining portion of the growth, but has also been followed by the development of a small abscess below the left eye which has had to be incised and which evidently communicates with the tumor mass.

DOCTOR McCREERY said he was somewhat skeptical of the value of radium in the treatment of a tumor composed as this one was of dense connective tissue and bone. However since the implantation of radium emanation there had been a certain amount of necrosis, and it may be that in this case a further attempt at local removal will be a wiser procedure than the resection of the superior maxilla.



FIG. 2.—Fibroma of lower jaw.

FIBROMA OF LOWER JAW

DR. JOHN A. McCREERY presented a man, thirty-five years of age, who was admitted to the First Surgical Division of Bellevue Hospital in May, 1927, complaining of a tumor in the floor of the mouth.

Four years before admission he noticed a small mass just behind the left lower incisor. This caused him no discomfort. The mass grew very slowly for about three and a half years at which time it was about 1 cm. in diameter.

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At this time it commenced to grow very rapidly to its present size, annoying him because he could not close his mouth over the mass and he felt that it was a disfigurement. It did not interfere with his speech or the swallowing of soft food.

On admission patient presented a tumor which appeared to fill the floor of the mouth. It was firm, slightly lobulated, ulcerated over a small area anteriorly where it projected when an attempt was made to close the lips over it. It apparently arose from a small pedicle attached to the alveolar process of the lower jaw behind the site of the right lower incisors. The tongue could be protruded over the left upper border of the mass. X-rays were reported as showing destructive changes in the anterior portion of the alveolar process.

At operation a firm tumor, measuring 7 by 6 by 4 cm. was removed by division of the pedicle which was attached along the gum line behind the lower incisors, but which apparently did not involve the bone. Microscopically, the tumor consisted of swollen collagen fibres closely resembling keloid, and was called by Doctor McWhorter a fibroma. The operative incision healed without infection and up to the present time there has been no evidence of recurrence. Patient shown because of the rather unusual size of the tumor.

TUMORS OF THE UPPER JAW

DR. GEORGE H. SEMKEN read a paper with the above title.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held November 7, 1927

The President, DR. CHARLES F. MITCHELL, in the Chair

RUPTURE OF OVARIAN CYST

DR. DAMON PFEIFFER reported the case of a young girl aged eighteen, who had been seized with an attack of acute abdominal pain associated with vomiting, elevation of temperature and leucocytosis. A diagnosis of acute appendicitis was made by the attending physician and the physical examination on admission to the hospital tended to confirm this. At operation the condition proved to be intra-abdominal hemorrhage due to rupture of a small ovarian cyst. The speaker had called attention to this condition in some detail in a case reported to the Academy in 1926 and at this time wished merely to reiterate that this condition must be borne in mind as a cause of acute abdominal symptoms.

TRAUMATIC RUPTURE OF THE URINARY BLADDER IN CHILDREN

DR. LLOYD B. GREENE, by invitation, reported two cases of traumatic rupture of the urinary bladder in young children. The first case was that of a boy, aged eleven, who was admitted to the accident ward of the Methodist Hospital, September 21, 1927, having been injured by an automobile. The patient was a deaf mute. There was an irregular deformity of the lower third of the left thigh and an irregular laceration of the lateral surface below this deformity. There was considerable bleeding from this wound. There was also a fracture of the descending ramus of the left os pubis. The abdomen was rigid and tender. A catheter was passed easily and pure blood obtained. Fluid introduced through the catheter was only partially recovered. A diagnosis of rupture of the bladder was made and operation was performed in the course of a few hours. The parietal peritoneum and the viscera were intact. There was considerable free blood and clots in the pelvis. The bladder was well mobilized in its lower half, and revealed a ragged punctured wound in the left lateral wall of the bladder near the sphincter and a clean tear about one inch in length in the anterior wall about the midline running to but not involving the sphincter. There was considerable bleeding from the lacerated pelvic fascia. The bladder was opened for thorough inspection and the laceration was closed from without. A number ten French catheter was fixed in the urethra and a DePezzer catheter fixed in the bladder and brought out through the suprapubic wound. The pelvis was packed with gauze and the wound closed. Urine was passed through the catheter seven hours after operation. The urethral catheter was removed on the fifth day. The packing was removed on the sixth day and there was no further bleeding. The DePezzer catheter was removed on the twelfth day, at which time normal urination had been fully established. The fracture was treated by overhead suspension in a Bryant frame. The child is still in the hospital.

The second case was that of a girl, aged four, who was admitted to the accident ward of the Methodist Hospital, August 5, 1927, after having been

struck by an automobile while playing in the street. There were bruises in the region of the both hips and slight bleeding from the vagina. The child was pale and listless, temperature 100.6, pulse 144, respiration 40. There was some rigidity over the entire abdomen, more pronounced on the left side. Pressure over the entire lower quadrant seemed to cause considerable pain. The signs of free fluid or gas in the peritoneal cavity were absent. She was given a hypodermic of morphine and soon thereafter slept. The X-ray examination showed a fracture of the right ischium without displacement. A number ten French catheter was introduced into the bladder and a few c.c. of blood were obtained by suction. A small quantity of water was introduced through the catheter but could not be recovered. The catheter was left in the urethra for half an hour. A few c.c. of blood were collected during this period. A tentative diagnosis of extraperitoneal rupture of the bladder was made and operation was elected. Through a left rectus incision the peritoneal cavity could be inspected without opening it. There was no evidence of intraperitoneal injury. The pre-peritoneal tissues in the region of the pelvis were suffused with blood. There were many clots and quite active bleeding, apparently from the depths of the pelvis. The bladder presented in the midline, above the pelvic brim. The urethra was torn across completely just distal to the bladder, the internal sphincter being intact, apparently. There was complete mobilization of the bladder except for the upper posterior segment. There were about 60 c.c. of clear urine in the bladder. The anterior and lateral walls of the vagina were severely lacerated and torn away from their anterior attachments back to the cervix. A small strip of the posterior vaginal wall, in which there were several longitudinal tears, was left in place. The cervix was readily seen by very gently retracting the bladder upward. The rectum was intact. The pelvic fascia was severely lacerated and bleeding profusely and the patient's condition was critical. A suprapubic cystotomy was done. A catheter was introduced through the external urethral orifice into the bladder and fixed with catgut. The bladder was drawn down into its normal position, using the urethral catheter as a tractor. The pelvis was packed with gauze and the wound closed. The patient reacted satisfactorily. The urinary output was small during the first fourteen hours. The pulse gradually came down and she secreted 840 c.c. of urine during the next twenty-four hours. The packing was removed on the tenth day. There was considerable bleeding and the wound was packed again. The urethral catheter which had been expelled from the bladder was lying free in the vagina and was removed. A strip of rubber tissue was placed in the vagina for drainage. There was a considerable secondary hemorrhage during the night. On August 20, blood count showed the hæmoglobin was 67 per cent., erythrocytes 2,250,000. She had a chill at this time followed by a temperature of 103° F. The urinary output fell to 400 c.c. The temperature assumed a septic type but returned to normal, after about one week. The suprapubic tube was draining very little, but the perineal dressings were constantly wet. Blood chemistry was within normal limits. The suprapubic tube was removed on September 9, and the wound allowed to close. On October 17, a small cystoscope was passed into the vagina and a ureteral catheter then introduced into the bladder. Sixty c.c. of five per cent. sodium iodide solution were instilled into the bladder and a cystogram made. This showed a normal bladder outline with slight displacement of the bladder to the left. The child was discharged on October 17. She now controls her urine and we hope at some future time to attempt reconstruction of the urethra by plastic operation.

SUTURE OF THE TENDONS AND NERVES IN BOTH WRISTS

SUTURE OF THE TENDONS AND NERVES IN BOTH WRISTS

DR. DANA WEEDE, by invitation, presented a patient aged twelve, who was admitted to the Germantown Hospital, November 2, 1926. This patient was shown for two reasons, first, the short time in which practically complete function had been obtained after the suturing of tendons and nerves, and secondly, to stimulate an interest in the study of the facts and details of anatomy. There is a tendency that has been growing in recent years to depreciate the value of knowledge of the details of anatomy and to curtail the time allotted to its study. This patient presented a problem, to be sure a little unusual in the extent of injury to structures, that would have disillusioned the mind of any surgeon of the wisdom in neglecting the careful study of anatomy. In being pursued by a playmate on November 2, 1926, this boy attempted to push open a swinging door, using both hands. His hands slipped from the lower half of the door, which was of wood, and broke through two panes of glass in the upper half of the door. He sustained two very jagged and extensive wounds of the flexor surfaces of both forearms. On the right side the four tendons of the flexor sublimis digitorum, the four tendons of the flexor profundus digitorum, the tendon and muscle fibres of the flexor carpi radialis and flexor longus pollicis, the median nerve, one-third the ulnar nerve, the radial and ulnar arteries and part of the annular ligament were cut. In the left forearm the tendons of the flexor carpi ulnaris, the flexor sublimis digitorum tendon to the little and ring fingers, the ulnar artery and part of the annular ligament, were cut. Within an hour after the injury the repair of the injured structures was begun. Badly torn muscle fibres and pieces of fascia that would have sloughed were excised, the ends of the cut tendons and nerves were freshened before suturing them. The tendons were sutured with No. 1 chromic catgut as were the torn muscles, and the nerves were sutured with fine silk. A very careful preparation of the hands and forearms with tincture of green soap, water, alcohol, ether and iodine was made before repair. A review of anatomy of the forearm and hands will aid in a better understanding of this case and show what to expect if normal function is to be reestablished. There are three flexors of the wrist, one of the radial side, the flexor carpi radialis, one for the ulnar side, the flexor carpi ulnaris, and one for the middle, the palmaris longus which is sometimes absent as in this case. The flexor carpi radialis also aids the extensor carpi radialis longior in abducting the wrist and the extensor carpi ulnaris aids the flexor carpi ulnaris in adducting the wrist. There is one flexor for the second phalanges of the four fingers, the flexor sublimis digitorum and one flexor for the third phalanges of the four fingers, the flexor profundus digitorum. The flexor longus pollicis flexes the second phalanx of the thumb. These muscles receive their innervation in the upper third of the forearm. The restoration of function therefore is only dependent in these structures upon proper suturing and union of the severed tendons. The foregoing accounts for the muscles that flex, abduct and adduct the wrist and the flexors of the second and third phalanges of the four fingers and the flexor of the distal phalanx of the thumb. The muscles that produce the other actions of the fingers are found in the hand and are innervated by one or two nerves, the median or ulnar. The muscles that aid in the flexion of the first or proximal phalanges of the four fingers are the four lumbricales and the anterior and posterior interosseous muscles. Beside their flexing action, they all by virtue of their insertion into the extensor tendons of the four fingers aid in the extension of the second and third phalanges. The lumbricales because of their insertion on the radial side of the fingers aid in drawing them laterally toward the thumb. The anterior interossei also draw

the fingers toward the middle finger, including the thumb, and the posterior interossei separate the fingers (moving the middle finger to either side) except the thumb and little finger this action being brought about in the case of the little finger by the abductor minimi digiti and of the thumb by the abductor pollicis. The little finger is further supplied with a short flexor inserted in the base of the first phalanx, the flexor brevis minimi digiti and an opponens minimi digiti which flexes and adducts the metacarpal of the fifth finger. The thumb is further supplied with a short flexor, the flexor brevis pollicis and an opponens pollicis which flexes and opposes the metacarpal of the thumb toward the ulnar side and an adductor pollicis which adducts the thumb. Considering now the nerve supply of the muscles of the hand, all are supplied by the ulnar except the abductor pollicis, flexor brevis pollicis, opponens pollicis and the two lumbricales on the thumb side which are supplied by the median. It is seen then that the ulnar supplies the greater number of muscles. Paralysis of the ulnar would result then in loss of flexion of the first phalanges of the four fingers, incomplete extension of the second and third phalanges of those fingers, inability to close and separate the fingers and partial inability to oppose the little finger on the thumb. The characteristic appearance of the hand in ulnar palsy is claw hand. Paralysis of the median nerve would result in loss of flexion of the first phalanx of the thumb, inability to abduct the thumb and partial inability in opposing the thumb to the little finger and a slight loss of power in drawing the index and middle fingers toward the thumb. As to sensation, both the ulnar and median nerves being mixed nerves, the median supplies the greater area of skin—the skin over the palm of the hand to the junction of the outer and middle thirds, the skin of the palmar surface of the thumb, index, middle and half of the ring fingers and the dorsum of those fingers over the distal phalanges. The ulnar supplies the rest of the skin on the palmar surface of the hand and the little finger and half of the ring finger.

Returning now to the patient, it was noted that he had perfect flexion, adduction and abduction of the wrists; strong flexion of all the phalanges of the four fingers and thumb on both sides; perfect opposition of thumb and little finger of both hands and separates well the fingers of both hands and closes them, except for a partial inability to close the little finger against the ring finger of the left hand. This is the only muscular disability. There has been a partial restoration of sensation over the palmar surfaces of both hands and all the fingers. The sense of touch is not as acute as normal yet; but with education and application the acuteness should return. It was interesting to note that motor fibres had regenerated more quickly apparently than the sensory. As to the post-operative treatment and course; the hands and forearms were kept in straight splints with roller bandages under the palms of the hands, for three weeks. They were not disturbed for two weeks. Every other day during the third week the fingers and wrists were moved and the splints reapplied. In a month passive motion and massage were begun twice a day and electrical stimulation with galvanism and faradism was given twice a week for five months. At the end of two months he was given a moderately hard tennis ball to carry with him to squeeze. The passive movements and massage were continued until four months ago. During the past four months he has had no special treatment except encouragement to continue doing wood carving and finger exercises on the piano. In December, one month after the injury, there was a spotty return of sensation in small areas. This gradually increased until there was sensation throughout in May. The muscles supplied by the median nerve on the right hand were the first to show regeneration which occurred about the end of December. Fairly complete muscle control was reestablished about the

SUTURE OF THE TENDONS AND NERVES IN BOTH WRISTS

middle of February, excepting the lateral approximation of the little and ring fingers of the left hand and a weakness in extension of the second and third phalanges of these fingers. Complete muscle control, excepting for this residual weakness in approximating the little finger against the ring finger was established by the end of the tenth month. The wounds remained absolutely free from infection until they had completely healed, which made possible to a large degree the excellent result.

DR. JOHN H. JOPSON said that two months ago he was summoned to the Bryn Mawr Hospital at 2.30 in the morning to see a man who had cut the tendons of the back of his hand. He had put his hand through the windshield of an automobile, cutting both tendons along the short extensor of the thumb between the metacarpal and the phalanx. The preparation and suture of the tendons took about an hour and a half. The speaker believes that such time is time well expended. He has now in his care a patient with a number of lacerations of the hand, who was first treated in another hospital and who now presents a condition opposite to that shown to-night; his hand was saved with difficulty and will be probably functionally useless as long as he lives. In this last case Doctor Jopson used black silk; for some time, he has been dissatisfied with chromic catgut as it has worked out in cases of suture of the flexor tendons, and black silk is superior in that there is less local irritation.

DR. DAMON B. PFEIFFER said that almost everyone sutures tendons differently. The books describe a great variety of complicated sutures. The speaker has finally adopted a suture devised by Doctor Harmer, of Boston, which he finds very simple, consisting of whipping over the sides of the tendon and tying both ends. The other methods of suture described, seem to be very complicated. In the last few years there has been a great deal of emphasis laid on the necessity for a suture which will allow early mobilization. This case of Doctor Weeder's would seem to show that this is not as important as we have been led to believe, as his case was mobilized two weeks later, with good results.

DR. HUBLEY OWEN said that cases of severing of tendons and nerves are not uncommon in the Police and Fire Department. Often a wall falls down on the hands or wrists of a fireman while he is going up a ladder. There is a great deal of incapacity for active duty due to these injuries. Doctor Owen has been fortunate with his results in suturing the tendons, but not the nerves. The speaker showed before the Orthopaedic Club, a man who while hunting, fell and cut the extensor tendons of the wrist. The tendons were sutured but apparently the tendons of the little finger and those of the fourth finger got mixed. Nature finally corrected the mistake after a few months and coördination was obtained.

DR. GEORGE M. DORRANCE said that he has seen a number of cases of primary suture which have later broken down. A number of years ago he gave up the primary suture, in cases where the wound might be infected, and used the secondary suture. He has had no reason to change his opinion. If the wound is presumably infected, he would rather clean it up first and

later do the secondary suture. The speaker's results have been better than when he did primary suture in wounds which he knew were filled with dirt and might be infected.

HERNIA INTO LESSER PERITONEAL CAVITY FOLLOWING GASTRO-ENTEROSTOMY

DR. CALVIN M. SMYTH, JR., reported the case history of a woman, aged sixty-one, who was admitted to the Methodist Episcopal Hospital on April 27, 1927, in the service of Dr. Damon B. Pfeiffer. For the past ten years she had suffered with pain in the epigastrium and vomiting. The pain was invariably worse after food had been taken, but was relieved by vomiting. The patient denied that the vomiting was ever induced and described it as being projectile in type. The pain was described as being "worse than labor pains". Occasionally there would be an abatement of symptoms for a few weeks, but never for longer than two months. Six years ago she was operated upon at which time she was told that her gall-bladder was drained and appendix removed. Following this operation she was somewhat improved for a period of one year, but for the past five years her symptoms had become progressively worse. Recently there had been an alternating constipation and diarrhoea; at times she would have as many as ten stools in a day and again the bowels would not move for three or four days at a time. She had had considerable gaseous distention. There had been no loss of weight. Apart from the operation, six years ago, the past history was negative, except for the passage of a tapeworm three years ago. Physical examination was essentially negative, except for the abdomen, which showed a moderate amount of distention and hyperperistalsis. There was vague tenderness over the entire right side, more prominent in the upper portion. The scar of the previous operation indicated that a right rectus incision had been made. No mass could be palpated. The usual examinations of blood, urine, faeces, gastric contents and the tests of kidney function were all within normal limits. Gastro-intestinal X-ray examination disclosed a dilated stomach which retained two-thirds of the opaque meal at the end of twenty-four hours. During the course of these studies the patient had two attacks of pain which were followed by vomiting of enormous quantities. Gastric and colonic lavage gave relief. A pre-operative diagnosis of chronic pyloric obstruction, probably benign, was made. At operation, May 6, on opening the abdomen the entire small intestine was markedly distended. In searching for the point of obstruction, it was found that the entire small bowel had herniated through an opening in the transverse mesocolon, passing into the lesser peritoneal cavity and in turn emerging through a second opening in the gastro-hepatic omentum, finally coming to lie in front of the stomach. After the "geography" of the situation had been worked out and the intestine restored to its normal relations, the upper abdomen was explored. There was no evidence of any operation having been done upon the gall-bladder; the stomach was tremendously dilated and there was a gastro-enterostomy located practically into the pylorus. The stoma was almost closed and showed the extensive induration characteristic of marginal ulcer. In view of the somewhat shocking procedure which the replacing of the intestines had entailed, it was thought unwise to subject the patient to gastric resection. A second posterior gastro-enterostomy was therefore made to the cardiac side of the existing one. Great care was observed in closing the defects in the mesocolon and the gastro-hepatic omentum. The patient made an uneventful recovery and was discharged from the hospital on May 27, 1927. She reported by letter in October, 1927, that she was quite well and entirely free

REDUCTION "EN BLOC" OF STRANGULATED HERNIA

from the symptoms for which she sought relief. This case was reported on account of the very unusual nature of the hernia and as an illustration of the trouble which may arise from failure to close the opening in the gastro-colic omentum in the operation of gastro-enterostomy.

REDUCTION "EN BLOC" OF STRANGULATED HERNIA

DR. CALVIN M. SMYTH, JR., reported the case of a woman aged thirty-one, who was admitted to the Methodist Episcopal Hospital on March 29, 1926. For the past five months she had noticed a swelling in the right groin which fluctuated in size and at times completely disappeared. The mass had at no time been painful or tender. On the evening of her admission to the hospital, the patient was seized with an acute colicky pain in the abdomen and at the same time the mass in the groin became larger and exquisitely tender. She felt nauseated but did not vomit. A physician who was called, diagnosed the condition as strangulated inguinal hernia and sent her to the hospital. He made no attempt to reduce the hernia by taxis. At the hospital she was examined shortly after admission but no mass could be demonstrated. Her temperature, pulse and respirations were normal and she complained of no pain. The following morning the patient wished to go home, but on further examination a mass the size of a hazelnut could be palpated in the groin. This was thought to be a gland, but on account of the previous history, she was advised to stay in the hospital for another twenty-four hours for observation. Thirty-six hours after admission the pulse rose to 130°, but the temperature remained normal. A blood count revealed 18,000 white blood-cells. She was seen by the reporter at this point. Doctor Smyth advised operative investigation of the mass. At operation on March 31, through an inguinal incision, the mass was exposed and was found to consist of a tab of pre-peritoneum fat which was protruding through the internal inguinal ring. On opening the peritoneum a foul odor was noticed and a finger introduced into the abdomen palpated a mass to the inner side of the ring. A piece of gauze was placed over the inguinal incision and the abdomen opened in the midline. A loop of ileum was delivered which proved to be completely gangrenous and was perforated at one point. A segment eight inches long was resected with the cautery and the continuity of the bowel restored by end-to-end anastomosis. A jejunostomy was made through a separate incision high in the left side and a catheter sewn in. The midline incision was closed without drainage; the inguinal incision was left open and the abdomen drained through this opening with two cigarette drains. The post-operative reaction was severe but the bowels moved normally on the fourth day. The drainage from the jejunostomy gave considerable trouble. The catheter came out on the fifth day but the opening continued to drain for seventeen days. This drainage was highly irritant to the skin, but excoriation was prevented by applying a thick paste of bismuth and zinc oxide. The drainage was removed from the inguinal incision on the sixth day and on the seventh day feces was discharged through the wound. The leak, however, must have been a small one, as drainage soon ceased and the wound was healed solidly at the end of the sixth week. The patient left the hospital at the end of the eighth week. She has been seen at regular intervals since and has had no trouble of any kind. In spite of the fact that the inguinal canal was never sutured in any way, there is no evidence of hernia. Doctor Smyth remarked that reduction "en bloc" is a comparatively rare accident. In the great majority of cases it follows an attempt at reduction by taxis. In this case as in a similar one reported to the Academy in 1926 by Dr. Stewart Rodman, no taxis had been employed. In a series of 137

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cases reported from the literature by Comer and Howith, there was a mortality of 48 per cent.

SPLENECTOMY FOR PERNICIOUS ANÆMIA

DR. SELLING BRILL, by invitation, presented a woman, aged fifty-seven, who was admitted to Doctor Stengel's service at the University of Pennsylvania Hospital, July 2, 1926, with the chief complaint of weakness. Her family and past history were irrelevant. She was a multipara. She did ordinary work of a housewife, and previous to the present illness slept well and followed an ordinary, well-regulated diet. The present illness began in April, 1925, when, following the death of her infant daughter, she became mentally depressed, and generally weak. She went to the seashore for six months to recuperate, but returned in October, 1925, unimproved. She remained in bed for six weeks. In March, 1926, she was sent to a local hospital for study. There she complained of vague abdominal pains, weakness, a peculiar feeling of her tongue, which she described as "a swelling", and a "pulling" feeling in her calf muscles. No numbness or tingling. Her temperature varied from 100 to 101°. For four months preceding entry to the University Hospital she had been mentally confused and grew weaker, and during the last four weeks she was confined to bed. Physical examination showed an elderly emaciated woman, constantly moaning and restless, very weak, with a peculiar lemon-yellow tint to the skin. She was dyspnoeic on any exertion. Mentally confused and disoriented, the conjunctiva were pale and had a lemon tint. She complained of buzzing in the ears. Cardiovascular system essentially negative. The abdomen was essentially negative, except for a palpable, moderately enlarged spleen. The eyegrounds showed moderate hemorrhages in both fundi. Vibratory sensation decreased in both lower extremities, especially the right. Patellar and Achilles reflexes decreased.

Clinical Pathology.—Urine—16 examinations—ambre specific gravity 1003 to 1015, averaging 1010. Reaction acid, albumen faint trace. Sugar negative. Red blood-cells once—white cells few to loaded. Casts of all kinds on many occasions. Urobilin one on the one examination made. The phthalein test showed forty per cent. in two hours. Blood urea nitrogen 19 mg. per 100 c.c. Blood—in fourteen examinations the red count varied from 900,000 to 2,000,000; hæmoglobin 23 per cent. to 50 per cent., both higher figures were following transfusions. The color index at all times was one. The average of all blood counts 1,500,000 red blood-cells, average hæmoglobin 36 per cent., giving an average color index of 1.2. The white count varied from 2900 to 11,600—average 4800. The smear showed nothing unusual in the distribution of the neutrophiles and lymphocytes. The differential count showed on the average of monocytes 3 per cent., eosinophiles 3 per cent., myelocytes 2 to 4 per cent., marked polychromatophilia, anisocytosis, poikilocytosis, macrocytosis; normoblasts 1 to 2 per cent., megaloblasts 1 to 5 per cent. Cabot ring bodies were noted twice. Reticulated reds 1.5 per cent. on one examination and 4 per cent. on another. The fragility test showed hæmolysis beginning at 2450 and completed at 375. The Van den Bergh test was direct negative, indirect 3.2 units. Blood culture negative. Blood Wassermann negative. Bleeding time three and a half minutes, coagulation time five minutes (capillary method). Platelets 50,400 one examination. Fæces—six examinations—were made, of which four were positive for occult blood. All were positive for bile pigments.

Patient remained on the medical service until October 10, and had eight transfusions averaging from 200 to 500 c.c. She kept going steadily downhill

SPLENECTOMY FOR PERNICIOUS ANÆMIA

and in view of the fact that the X-ray of the gastro-intestinal tract showed "constant constriction of the pyloric region due possibly to carcinoma", surgical consultation was asked for and laparotomy advised. At this time the patient weighed 88 pounds. She was transferred to the surgical service and operated upon by Dr. George P. Muller, October 16, 1926. The stomach, pylorus and duodenum disclosed no pathology. The gall-bladder was slightly thickened, contained two rather large stones and the spleen was found to be twice the normal size. After some discussion it was decided to remove both. Toward the end of the operation she was transfused—250 c.c. of blood by the citrate method. Closure in layers without drainage.

Pathological report of the gall-bladder showed a chronic interstitial cholecystitis. Pathological report of the spleen showed the usual hypertrophic change, but nothing of significance. The patient made an uneventful recovery and repeated examinations of the blood showed a steady improvement.

At the examination of the follow-up clinic in February of this year note was made that she was looking remarkably well, had gained over twenty-five pounds in weight, color was good, had regained strength, had good appetite and good digestion. She was seen again the following May and had gained another twenty-five pounds. She was last seen October 26, 1927, she weighed 149 pounds, had no soreness of the tongue, or paresthesias of the extremities. Physical examination showed no jaundice and a normal tongue. The blood examination at this time showed: Red blood-cells, 3,940,000; white blood-cells, 10,900; hæmoglobin, 96 per cent.; platelets, 272,000. Fragility test begins at .450, complete at .275. Reticulocytes 0.5 per cent. Van den Bergh direct negative, indirect 0.2. Clotting time ten minutes. Clot retraction normal. Cell volume, 47 per cent. Differential normoblasts, 50 per cent.; small lymphocytes, 31 per cent.; monocytes, 4.5 per cent.; eosinophiles, 3.5 per cent.; basophiles, .5 per cent. Smear—macrocytosis marked. Many Howel Jolly bodies. A few basic stypled macrocytes. No nucleated red cells. Some giant platelets. A gastric analysis had never been done because the patient had never been able to swallow a stomach tube. She has eaten about one pound of liver a week since discharge.

The reporter said that this was a fairly clear case of primary pernicious anæmia, although three things were lacking. More definite cord symptoms, a better history of glossitis, and gastric analysis. The diagnosis of hæmolytic ictero-anæmia was considered, but in this disease the anæmia is very rarely severe in the familial type, color index is usually low, microcytosis is the rule instead of macrocytosis as in this case. The finding of gall-stones is more in favor of the diagnosis of hæmolytic ictero-anæmia. From the present laboratory examination this patient still suggests primary pernicious anæmia. The color index is high, macrocytosis is marked. The cell volume is well above normal for women. In considering the excellent result there are three factors: the operative procedures, including splenectomy and cholecystectomy, and the liver diet that the patient had followed since discharge. The liver diet although definitely inadequate (Minot recommends at least 200 grams daily) has been sufficient quantity to have possible effect on pernicious anæmia. Patient said she has eaten one-half pound of liver twice a week, which amounts to an average of 60 to 70 grams daily. Splenectomy has been generally given up in pernicious anæmia. However, it has undoubtedly helped some cases of the hæmolytic type and is known to produce clinical cure of hæmolytic ictero-anæmia. The association of primary pernicious anæmia with chronic gall-bladder disease was first noted by Georgi in 1887. More recently, Jones and Joyce in two reports in 1924 and 1927 report 24 consecutive cases, 15 of undoubted pernicious anæmia and 7 of probable or

borderline anaemia, all complicated with gall-bladder disease, and the anaemia remarkably improved in several cases following cholecystectomy.

DR. GEORGE P. MULLER said that including the case reported by Doctor Brill, he had performed splenectomy eight times for pernicious anaemia. All of the cases recovered from operation. One patient lived twenty-three months but was given five transfusions—at irregular intervals. Four cases were not improved at all and died, two, three, seven and seven months respectively, after operation. One patient was operated upon in June, 1915, and eleven years later was under the speaker's care for an infection of the thumb complicated by diabetes. He can be considered as entirely cured of the pernicious anaemia and was undoubtedly case diagnosed by Doctor Stengel. Another patient had the splenectomy done in November, 1922. Five years later he reported himself well, but Doctor Muller found that his haemoglobin was twenty-four per cent.; the red cells 1,370,000. The blood picture is that of pernicious anaemia. It will be interesting to note the effect of a "liver diet". While it is probable that splenectomy will now be performed less frequently, yet Griffin has recently (1927) stated that it is probable that splenectomy combined with other methods of treatment may eventually have a more significant place in the management of pernicious anaemia.

PLASTIC OF FACE AND JAW FOLLOWING EXCISION FOR CARCINOMA

DR. GEORGE P. MULLER reported the case of a patient who had a repair for a defect of the face and jaw following excision for carcinoma. The patient, forty-nine years of age, was referred by Dr. George Pfahler in June, 1923, suffering from an extensive carcinoma of the cheek with extension on to the alveolar process of the lower jaw. The X-ray shows erosion down to the level of the inferior dental canal. There is metastasis to the submaxillary lymph-nodes. Doctor Pfahler proposed destruction of the diseased area by electro-coagulation with dissection of the lymph-nodes and excision of the inferior maxilla. Preceding the operation he gave him treatment with the high voltage rays externally and surface applications of radium internally. On June 21, 1923, the operation was performed and included a bloc dissection of the neck upward from the omohyoid and removal of the entire lower jaw from about one inch from the symphysis backward. The electro-coagulation destroyed almost the entire cheek from the zygoma to the jaw and included the angle of the mouth. He was discharged on July 7, 1923, to report back to Doctor Pfahler for post-operative radiation treatment. On December 12, 1923, Doctor Pfahler reported a small area at the lower edge of the scar which looked suspicious. It was destroyed by electro-coagulation after a biopsy, but this showed evidence of recurrence. He was then given a dose of high-voltage X-rays. Shortly thereafter we began to think of ways and means to close the hole in the face. The first intention was to turn up the flap from the neck and cover the outer raw area with a second graft from the neck nourished through a Gilles tube. The first stage of this operation was done on February 11, 1924, but a few days later a flap of skin which had been turned up showed gangrene and ultimately sloughed away. A few weeks later a second Gilles tube was made and in April flaps were dissected corresponding in size to the opening in the cheek and were then sewed back into their place. A few weeks later they were again detached, the raw areas apposed, and both flaps buried into one of the sites in the neck. A week later, the flap faced on both sides with skin and connected by two Gilles

COLONIC ANÆSTHESIA IN OPERATIONS UPON THE BRAIN

tubes, was sutured into the defect in the face. The flap healed pretty well and the patient was sent away for the summer. In October, 1924, and subsequently through 1925 a succession of small plastics was done until all holes leading into the mouth were sealed up, except that a communication above with the edge of the superior maxilla could not be closed owing to osteitis of bone. At no time has there been any evidence of recurrent malignant disease and to-day, about four and a half years after the primary removal, he seems free of malignancy.

COLONIC ANÆSTHESIA IN OPERATIONS UPON THE BRAIN AND SPINAL CORD

DR. CHARLES H. FRAZIER read a paper with the above title, for which see page 161.

DR. FRANCIS C. GRANT said that in Doctor Frazier's absence this past summer, he used colonic anæsthesia, particularly in laminectomies and where he was doing rhizotomy for pain in the mouth and neck following carcinoma of the jaw and neck and in which we did not want to give anæsthesia by mouth on account of the slough carried into the oral cavity. He used the technic which Doctor Frazier outlined and it proved to be very satisfactory. Of course the pre-operative preparation seems very elaborate and that technic should be carefully followed in order to get the best results. Doctor Grant thought that the procedure did not lend itself to general surgery, because of the necessity of speed in handling a number of cases. All the neurological surgeon expects it to do is to keep the patient quite still and it will accomplish that. Where a major procedure is being carried out under local anæsthesia, often the patient will start to fret and the pulse goes up and one must resort to ether. There is no such difficulty with colonic anæsthesia. There is only one objection that the speaker has and that is when one needs enteroclysis given on the table.

DR. ROBERT IVY remarked that he reported to the Academy in 1926 the results in the use of colonic anæsthesia in 30 or 40 cases of operation about the face and head and he believes that this is the ideal method of anæsthesia in cases taking longer than one hour, because the anæsthetizing apparatus is always away from the parts being operated upon. In addition there are the advantages which Doctor Frazier has outlined. For shorter operations, the amount of preparation necessary for colonic anæsthesia does not make it worth the trouble. The speaker has found that the results are better with women patients than with men; he thinks that this is due to the fact that the male patients are prepared by orderlies and are not prepared as thoroughly and carefully as are the women patients, who have the care of nurses.

BRIEF COMMUNICATIONS

ACUTE INTUSSUSCEPTION IN INFANTS

In the following paragraphs, which are a part of a paper on the subject of acute intussusception in infants read by me before the Southern Surgical Association in December last, I present my personal experience.

The present series comprises twenty-five consecutive cases, with twenty-five operations and one spontaneous reduction of the intussusception. In one case, an infant of six months, was re-operated on for a recurrent ileo-colic intussusception three months after the first operation. He has since remained well. Though comparatively small, this series presents many of the vagaries of this strange disease. All but three were under one year of age, the oldest was seven years, the youngest three months. Out of the entire series, there were only six females. The majority of the intussusceptions were of the typical ileo-colic type. There were two purely enteric intussusceptions, a baby of three months and a child of seven years, in both of whom resection of terminal ileum was done for gangrene, with death in each case. A Meckel's diverticulum was the cause in a girl of four years, in whom resection was done, followed by death. There were two cases of compound intussusception, one in a baby of four months and the other in a child of three years and three months. After the mass in the colon had been reduced, there was still an intussusception of the small bowel with the apex in the cæcum and colon. Both infants had a quiet convalescence.

Of the twenty-five operations, there were seven deaths, an operative mortality of 28 per cent. Of these seven deaths, there were five resections, which means that the diagnosis or the institution of surgical treatment was too long delayed in five cases. One of the other two fatal cases was a male baby of eight and a half months which had been ill for three or four weeks with ileo-colitis and in whom the occurrence of an ileo-colic intussusception was a complication of this already grave disease. He died about twelve hours after operative reduction of the intussusception. In the other case, although reduction was not difficult, the baby did not survive the operation many hours. There seemed to be an unusual degree of toxæmia present. These details therefore obviously indicate that in the uncomplicated case of intussusception, if operative reduction is promptly done, the mortality rate may be greatly lowered. The problem then would seem that of prompt diagnosis.

Of the patients who recovered, there are found a number of facts perhaps worthy of note. There was one negro, eight and a half months, in the series. In a baby of eight months, while under examination, he strained and forced the apex of the intussusception about three inches to the outside of the anus. This was promptly replaced, an immediate operative reduction performed, and the infant went on to an uneventful convalescence.

In the whole series the only symptom that was constantly present was the periodic paroxysms of abdominal pain, abrupt in onset, usually associated

ABDUCTION TREATMENT FOR FRACTURE OF FEMUR

with evidences of shock, as indicated by the striking pallor and rapid pulse, and soon followed by reflex vomiting. The appearance of blood and mucous in the stools was a variable symptom. There were five instances in this series in which there was no blood passed by bowel. Fever was usually present, although in the early stages it was absent. In all but five of our cases the temperature was over 101 on admission to the hospital. The finding of a tumor has not always been possible. In one of our cases the tumor was not felt on first examination but two hours later it was distinct, which brings out the value of repeated examinations at short intervals in a suspicious case.

In one instance the tumor could be palpated only by rectum, in another the outlines of the mass could be seen on the abdominal wall in a well-nourished baby and was lying transversely across the epigastrium. In five cases the tumor was not palpated at all, in a sixth was doubtful, and in another only under anaesthesia. It is in these cases that the barium enema and fluoroscopic examination are of the greatest help, particularly when corroborated by suggestive symptoms.

Marked distention of the abdomen was present only in six cases, and was moderate in a seventh. These are the seven fatal cases, and it may therefore be considered of very ominous import. Presumably this is present only when obstruction of the bowel develops and is a late manifestation.

Fluoroscopic examination after a barium enema was used seven times in the series, although we have made much more frequent use of it in suspected and unproven cases. In each of these seven instances, it gave positive results. Occasionally we have been able to get a plate which gives a beautiful representation of the apex in the bowel lumen. Usually the baby promptly expels the barium before this can be done. In one baby this method of diagnosis was very helpful. It was an early and quite doubtful case, the pain was not as severe as is usual, the tumor could not be felt, and there was no discharge of blood and mucous from the rectum. The tumor was found at operation much as has been indicated by the fluoroscope, high up beneath the liver in the right side.

The earliest operation of the series was seven hours after onset and the longest five days.

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THE ABDUCTION TREATMENT FOR FRACTURE OF THE NECK OF THE FEMUR

I have read with interest Doctor Moore's paper in the last issue of the *ANNALS OF SURGERY*, in which he describes the abduction treatment for fracture of the neck of the femur applied in flexion instead of extension. The purpose of the modification is to permit the assumption of the sitting posture immediately after the application of the plaster spica. It was originally devised for aged patients but the author apparently employs it at the present time in all cases.

From this standpoint the paper is of especial interest because it is now generally admitted that fracture of the neck of the femur may be treated like

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other fractures, and since such treatment has been made practicable by the abduction method the question at issue is of its proper application.

Granting that the mechanism of the hip-joint may be utilized as effectively in flexion as in extension, what may be called the orthodox method, namely: fixation of the limb in full abduction, full (hyper) extension and slight inward rotation has, in comparison, the following advantages:

1. The effectiveness of the abduction method in restoring the normal relations of the injured part is confirmed by an exact correspondence of the anatomical landmarks on the two sides, a comparison possible only when the limbs are in the same relation to the pelvis.
2. The application of the method, including the adjustment of the plaster spica is, by comparison with that described by Doctor Moore, very simple, requiring only a secure pelvic support with a perineal bar against which manual traction on the extended limbs may be exerted.
3. The attitude of complete extension forces the fragments forward and thus checks the tendency to displacement in the cases, in which there is disintegration of tissue, preliminary to repair.
4. Complete extension assures the normal lumbar lordosis and lessens the pressure on the sacrum.
5. The extended attitude permits the alternation of the dorsal and ventral attitudes in recumbency, a most important element in the treatment.

The only question, therefore, is whether the possible advantage of the sitting posture for the patient will counterbalance its manifest disadvantages as concerns the fracture. From my own experience I conclude that the danger of bed treatment has been greatly exaggerated. Under former conditions patients with broken hips died because of pain, infected bed sores and mental and physical depression, not because they lay in bed.

At the present time the elevation of the head of the bed, the frequent changes of posture, the transportation to the open air, the freedom from pain and the expectation of recovery have practically eliminated the danger of treatment.

In the rather extensive bibliography appended to the paper the only reference to my work is to a paper published in 1921. The abduction treatment was described in detail in the *ANNALS OF SURGERY* for January, 1925, to which those who may be interested in the comparative merits of the original and modified methods are referred.

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